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Experiments in Crop Rotation and Fertilization

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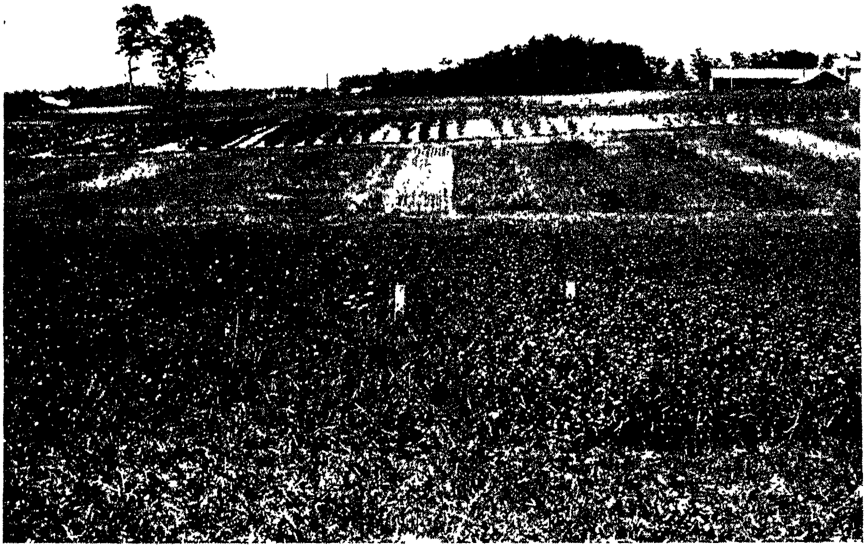

FIELD ON WHICH THE EXPERIMENTS WERE CONDUCTED

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EXPERIMENTS IN CROP ROTATION AND FERTILIZATION[1]

R. G. WIGGANS

In 1914,[2] at the New York State College of Agriculture, a series of cropping systems including oats, wheat, potatoes, grass, and clover in various combinations was planned to demonstrate the ordinary principles of rotation and to study the effect on yield of continuous cropping, of alternate grains, and of grass, clover, or a cultivated crop in the rotation. Each system was studied under three conditions: without the addition of fertilizer of any kind, with the addition of a complete fertilizer, and with the addition of both a complete fertilizer and manure. This report gives the results from these plots from 1914 to 1921 inclusive. At the end of that time the plots were discontinued because the crops work was reorganized by the College. This period of time, however, extended over two complete rotations on all plots. Since each crop in the rotation was grown each year, a period of six to eight seasons is covered with each crop in the various combinations This number of seasons proved sufficient for some of the purposes for which the series was established.

SOIL

The experiments were conducted on a rather heavy clay loam soil which had a medium amount of plant-food material but was somewhat deficient in organic matter. The soil was retentive of moisture, rather cold, and slow to dry in the spring, and had a strong tendency to puddle if worked when the moisture conditions were slightly unfavorable. Winter grains and new seedlings of clover were always heaved to considerable extent during the winter and to a greater extent during the early spring. The surface drainage of the plots was good except for a very small area at the extreme end of the second series. In 1919 tile drains were laid to a depth of 18 inches to the top of the tile between every other plot so that the drainage was made as nearly uniform as possible. Extreme care was exercised in placing the drains, in order that the plots would be disturbed as little as possible.

PLAN OF THE EXPERIMENTS

Plots

The plots were 7.5 feet x 70 feet in size and were laid out in parallel. Only a six-inch space was allowed between them, and this was kept as clean of vegetation as possible. Each plot was divided into thirds with two feet of space between each third. This plan made the final unit only 7.5 feet x 22 feet, or 1/264 acre in size, for any one treatment (figure 1).

[1] Paper No. 131, Department of Plant Breeding, Cornell University, Ithaca, New York.

[2] The plans for this work were made by Professor E. G. Montgomery, now with the Bureau of Foreign and Domestic Commerce, Department of Agriculture, Washington, D. C. The plots were laid out and the field work was inaugurated by Professor W. C. Etheridge, of the College of Agriculture, University of Missouri, who also obtained the data for 1914. Beginning with 1915 the work has been carried on by the author.

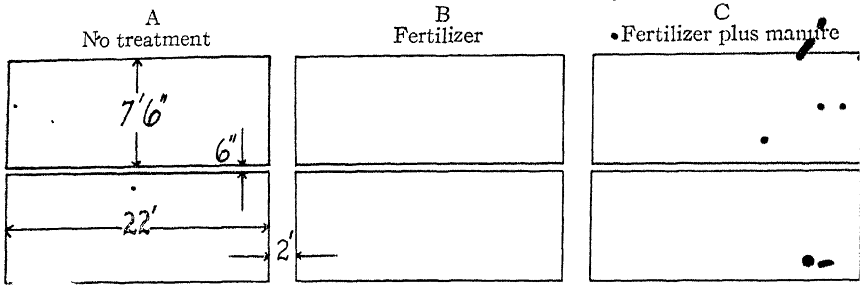

FIGURE I. DIAGRAM SHOWING ARRANGEMENT AND DIMENSIONS OF PLOTS

Cropping systems

The cropping systems for the first three years of the experiment are given in table I. In the succeeding three-years periods, the land was cropped in like manner except that the system of alternate oats and

TABLE I. CROPPING PLAN OF ROTATION EXPERIMENTS FOR YEARS FROM 1914 TO 1916 INCLUSIVE

Plot no.	Cropping system	Year		
		1914	1915	1916
402 403 404 405	Continuous cropping Continuous cropping Continuous cropping Continuous cropping	Oats Wheat Grass Potatoes	Oats Wheat Grass Potatoes	Oats Wheat Grass Potatoes
406 407	Alternate grains Alternate grains	Oats Wheat	Wheat Oats	Oats Wheat
408 409 410	Grains, cultivated crop Grains, cultivated crop Grains, cultivated crop	Oats Wheat Potatoes	Wheat Potatoes Oats	Potatoes Oats Wheat
411	Check	Oats	Wheat	Grass
412 413 414	Grains, grass Grains, grass Grains, grass	Oats Wheat Grass	Wheat Grass Oats	Grass Oats Wheat
415 416 417	Grains, grass, cultivated crop Grains, grass, cultivated crop Grains, grass, cultivated crop	Oats Grass Potatoes	Grass Potatoes Oats	Potatoes Oats Grass
418 419 420	Grains, clover Grains, clover Grains, clover	Oats Wheat Clover	Wheat Clover Oats	Clover Oats Wheat
421	Check	Oats	Wheat	Grass
422 423 424	Grains, clover, cultivated crop Grains, clover, cultivated crop Grains, clover, cultivated crop	Oats Clover Potatoes	Clover Potatoes Oats	Potatoes Oats Clover

wheat was repeated every two years instead of every three. This complete series was repeated once in plots 427 to 449 inclusive.

The plan shows that each crop in a given rotation appears each year; that all plots of a given rotation are adjacent; that rotations differing only slightly appear close together; and that checks are very infrequent, in fact they are farther apart than many of the comparisons that it is desirable to make. The system whereby each crop in a rotation appears each year insures a more accurate determination of the effects of the rotations, since the factor of seasonal differences is minimized.

Fertilization

As previously stated, each plot was divided into three sections: A, B, and C. From each of these sections the entire crop was removed except the potato tops, so that all sections were treated alike so far as the crop was concerned. Section A received neither fertilizer nor manure. Section B received an annual application of fertilizer which varied somewhat with the different crops according to the following formulas and amounts:

Crop	Formula	Amount per acre
Grain	3–8–6	200 pounds
Grass	8–8–6	200 pounds
Potatoes	3–8–8	400 pounds
Clover	3–8–8	200 pounds

The fertilizers were carefully weighed and thoroughly mixed before they were applied. Applications were made by hand, as uniformly as possible, at the customary time of fertilizing the individual crops.

The fertilization of oats was done at planting time (from April 10 to May 1), while the fertilization of grass and clover was done in the spring as near May 1 as was convenient. Wheat and potatoes were fertilized at planting time, which was approximately September 15 for the wheat and June 5 for the potatoes. Section C received the same fertilizing treatment as section B, with an application of manure in addition. The quantity of manure added was approximately the quantity which could have been made by stall-fed cattle from the crop removed the previous season. The first application was made in 1915. The calculation of the amount to apply was made according to Heiden's formula (Storer, 1906):

$$(D \times E) + \frac{D}{E} = M$$

In this formula, D = dry weight of crop; E = factor for multiplying dry weight of crop to find pounds of fresh excrement; M = manure manufactured from the crop.

The factor E varies with the sort of animals producing the manure. For cattle the factor is 3.84. This is the factor used for all the calculations in these experiments. (In figuring dry weight, potatoes were considered 25 per cent dry matter, grain and straw 90 per cent, and hay 80 per cent, when actual dry weights were not determined.) The application of manure

was made as a top-dressing to all plots in the spring just before the oats were seeded. It was worked into the topsoil to some extent for oats and potatoes.

All plots received one application of lime at the rate of 3000 pounds per acre in 1919 or 1920. The application was made wherever possible in the fall before wheat.

Physical treatment

The plots were spaded by hand to a depth of eight inches and prepared for planting by the use of a narrow disk and harrow, care being taken to drag the least possible amount of material from one section to another. In fitting the plots, the first diskings were made from section A to B to C. All the fitting was done lengthwise of the plots, as crosswise fitting was impossible on account of the different crops in adjoining plots.

Seeding and harvesting

The grains were drilled with a five-hole single-horse drill during the first years of the experiment. This method gave ten rows nine inches apart on each plot. Later, because of irregularities occurring from a stopped-up hole of the drill or from some other cause, the grains were drilled by hand in the same manner as rod rows. Where this was done, eight rows eleven inches apart were used, and exact amounts of seed by weight seeded in each section. The spaces between and the extensions on the ends of the plots were seeded with surplus seed. The grass plots were seeded by hand uniformly at the time of seeding the grain, and then covered lightly by means of hand tools. The potatoes were spaced so as to give the same number of hills on each section, with one hill in each row between sections and two hills in each row beyond the ends of sections A and C. When any seed piece failed to develop in the plot, the end hills were transplanted, so that a perfect stand was secured in nearly all plots.

At harvest, the sections were set apart by removing the surplus crop from the ends of the plots and from the space intervening between the sections.

METHODS OF CALCULATION

The method of calculating all data given in the following tables is the so-called Student's method (1908 and 1917), which is advocated by Love and Brunson (1924) for the handling of data similar to those presented in this bulletin. This method permits of the pairing of the yields of an individual crop each year in each comparison, thus giving weight to the amount and consistency of individual differences in estimating the significance of the mean difference. By the determination of the probable error according to Bessel's or Peter's formula as an aid in interpreting the significance of a given lot of data, the consistency of differences in both amount and direction is often completely overshadowed by large seasonal variations. Seasonal differences which enter so largely in the final expression of the determination of the probable error, affect very little the final results as determined by Student's method and expressed in odds.

The check plots 411, 421, 436, and 446 have not been used on account of their infrequency, regardless of the fact that they showed a rather marked and fairly consistent difference for the three crops (table 2).

TABLE 2. YIELD OF CHECK PLOTS EXPRESSED IN TERMS OF PERCENTAGE OF YIELD OF PLOT 436

Crop	Plot no			
	411	421	436	446
Oats..	60 9	88 9	100	95 0
Wheat	78 6	102 5	100	85.9
Grass..	80 3	97 8	100	97 2
Average ..	73 3	96 4	100	92 7

These figures represent the comparative yields of oats for three years, and of wheat and grass for two years each.

The only other data of any value in determining the variation in the land represent the yields of oats for the first year of the experiment. If these yields were plotted, the results would correspond very closely to the average percentages of oats given in table 2. They showed further that the poorest land was probably occupied by plots 408 and 409, and that plots 407 to 402 gradually improved and were probably somewhat better than 411. These last observations may account for the apparent lack of difference between yields of continuous grains and of alternate grains shown later in the bulletin. In connection with disregarding checks, it should be stated that most of the comparisons were made between plots which were closer together than were the checks. Particularly is this true where the comparisons were made between rotations with only slight differences. Furthermore, there is no assurance that the soil was graded uniformly from one check plot to another, especially when they are from 80 to 120 feet apart. When comparisons are made between cropping systems used on plots considerable distances apart, the variation in the soil in the two series is in the reverse direction (table 2), thus tending to neutralize the effects; at the same time the variation is increased, so that a greater difference is necessary to show significance.

The method of calculation for the first comparison in table 3 (page 8), that of the straw and grain yields of oats in continuous culture with straw and grain yields of oats in a system where oats and wheat alternated, and for the second comparison in table 23 (page 41), that of the oats yields without fertilizer, with fertilizer, and with fertilizer plus manure, in an oats-wheat-oats-wheat system, is given in the appendix. This method of calculation has been employed in obtaining all the data given in tables 3 to 31 inclusive.

COMPARISON OF THE VARIOUS CROPS IN THE DIFFERENT CROPPING SYSTEMS

One of the problems to be studied by this experiment is the comparison of the effects of the different cropping systems on the yields of the various crops. In order to do this, all the data for the several years are summarized in tables 3 to 22. For the sake of simplicity one crop is considered at a time and studied in all the various combinations; for example, all the data dealing with oats are found in tables 3 to 9, those dealing with wheat in tables 10 to 14, and so forth.

TABLE 3. COMPARISONS OF YIELD OF OATS GROWN CONTINUOUSLY, WITH YIELDS OF OATS GROWN IN OTHER CROPPING SYSTEMS*

Section of plot	Rotations with which continuous oats are compared	Yield of continuous oats (pounds)	Yield of oats in rotations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ†	Z	N	Odds
				Grain					
A	O-W-O‡	3.171	3.619	0.45	14 2	0.971	0.46	14	15:1
	O-W-P	3.171	4.106	0.94	29.6	0.744	1.26	14	3,565:1
	O-W-G	3.230	3.112	−0.12	− 3.7	1.190	0.10	13	2:1
	O-G-P	3.171	4.076	0.91	28 7	1 544	0.59	14	37:1
	O-W-C	3.171	4.084	0.91	28.7	1.700	0.54	14	25:1
	O-C-P	3.171	4.395	1.22	38.5	1.922	0 63	14	47:1
B	O-W-O	3 696	4.344	0.65	17.6	0 779	0.83	14	187:1
	O-W-P	3.696	4.806	1.11	30 0	0.577	1.92	14	>10,000:1
	O-W-G	3.696	4.078	0.38	10.3	1.061	0.36	14	8:1
	O-G-P	3.696	5.033	1.34	36.3	1 714	0.78	14	136:1
	O-W-C	3.696	4.764	1.07	29 0	0.963	1.11	14	1,332:1
	O-C-P	3.696	5.776	2.08	56.3	1.664	1.25	14	3,332:1
C	O-W-O	4.478	5.332	0 85	19.0	1 468	0 58	14	34:1
	O-W-P	4.478	5 935	1.46	32.6	1.468	0 99	14	582:1
	O-W-G	4.478	4.516	0.04	0.9	1.593	0 03	14	<1:1
	O-G-P	4.478	5 499	1.02	22.8	1.495	0.68	14	67:1
	O-W-C	4.478	5.585	1.11	24.8	1 454	0.76	14	115:1
	O-C-P	4.478	6 230	1.75	39 1	1.700	1.03	14	749:1
				Straw					
A	O-W-O	6.575	7.342	0 77	11.7	2 063	0.37	12	7:1
	O-W-P	6.575	8.144	1 57	23 9	2.267	0.69	12	46:1
	O-W-G	6.741	7.177	0.44	6.5	2.351	0.19	11	3:1
	O-G-P	6.575	7.402	0.83	12.6	3.312	0.25	12	4:1
	O-W-C	6.575	8.815	2.24	34.1	4.562	0 49	12	14:1
	O-C-P	6.575	8.050	1.47	22.4	4.072	0.36	12	7:1

B	O-W-O	7.804	9.683	1.88	24.1	2.441	0.77	12	73:1
	O-W-P	7.804	9.698	1.89	24.2	1.557	1.21	12	948:1
	O-W-G	7.804	8.540	0.74	9.5	2.136	0.35	12	6:1
	O-G-P	7.804	9.154	1.35	17.3	2.948	0.46	12	12:1
	O-W-C	7.804	10.614	2.81	36.0	2.448	1.15	12	666:1
	O-C-P	7.804	11.475	3.67	47.0	3.001	1.22	12	989:1
C	O-W-O	10.769	11.908	1.14	10.6	2.204	0.52	12	17:1
	O-W-P	10.769	12.111	1.34	12.4	1.997	0.67	12	40:1
	O-W-G	10.769	9.379	-1.39	-12.9	1.973	0.70	12	48:1
	O-G-P	10.769	10.771	0.00	0.0	2.337	0.00	12	<1:1
	O-W-C	10.769	13.665	2.90	26.9	3.193	0.91	12	169:1
	O-C-P	10.769	12.217	1.45	13.4	2.485	0.58	12	24:1

* All yields are given in pounds per plot and represent the average of (N) yields. Multiply by 264 to reduce to acre yields.

† The standard deviation is large in each instance, so that large differences are necessary to show a significance. The necessity of having these differences has at times been overlooked, and the average difference or average percentage difference been given entirely too much weight.

‡ The first letters of the various crops, oats, wheat, potatoes, grass, and clover, are used to indicate that crop in the rotation.

In discussing the results given in the various tables, the last column, that dealing with odds, is probably the most important as it gives a fairly accurate measure of the significance of differences. In other words, a large actual difference with high standard deviation and low odds is less significant than a smaller difference with low standard deviation and high odds.

Odds much below 30.1 only indicate tendencies, while greater odds approach certainty as a limit.

The yield of oats grown continuously is compared in table 3 with the yields of oats grown in various other cropping systems. Positive differences in favor of all systems over continuous cropping are shown in this table in the yields of both grain and straw, with the one exception of the O-W-G rotation. Some of the gains in both grain and straw, although positive, are not significant. Oats are seen to be slightly better following potatoes, a cultivated crop, than they are following clover. Clover is easily superior to grass in rotation for increasing the production of oats under the conditions of the experiment. Moreover, the yields of oats in a system of alternate grains are only slightly better than those of continuous oats, some of the differences being insignificant.

The exception mentioned, that no positive advantage exists for oats in an O-W-G rotation over continuous oats, is rather unexpected but is conclusive for the conditions under which the comparison was made. It would not seem advisable, therefore, to follow grass with oats. To be sure, such a practice is not common, but it is well to know what the probable outcome of such a method would be. The reasons for such results are not entirely apparent, but the lack of ability on the part of oats to make use of coarse organic matter is probably the most important.

Yields of straw show greater increase when fertilizer was used than when no treatment was given. The greatest increase occurred in the rotations including clover, and, with one exception, following clover directly.

The yield of oats grown alternatingly with wheat, and the yields of oats grown in various other cropping systems, are compared in table 4. The disadvantage of following oats with grass is again shown, as it is also in several of the succeeding tables. The yields of oats in an oats-wheat-oats-wheat system are greater than the yields following grass by 7.01 to 21.4 per cent, although in most comparisons the odds are low. Further comparisons show that the grain yields of oats in the oats-wheat-oats-wheat system are poorer than the grain yields of oats in the other systems, with the exception of the yields of continuous oats already mentioned. The differences are from 3.2 to 32.9 per cent, with only a few positively significant as indicated by the odds. On the other hand, the straw yields differ very slightly except in those instances of negative differences already cited. In fact, there is no significant difference in any instance, although the percentage differences vary from −9.6 to +20.0 per cent, the lowest being found in the O-G-P combination and the highest following clover in the O-W-C combination.

The yield of oats grown in an O-W-P rotation and the yields of oats grown in various other cropping systems are compared in table 5. The advantage of introducing a cultivated crop into the rotation is very readily seen by this table, since the grain yields of oats are significantly higher, ranging from 9.6 to 26.8 per cent, with the exception of the O-W-C

rotation where the introduction of clover makes up the difference. Even in comparison with the O-W-C rotation, the differences are slightly in favor of the O-W-P system in sections A and B, although they are not significant. The advantage of substituting clover for wheat in an O-W-P rotation is shown in all sections, the gain varying from 4.9 per cent to 20.2 per cent. The odds in favor of significance are not high in any comparison.

The effect of this rotation on the amount of straw gives it a distinct preference over the O-O-O and O-W-G combinations, but no marked advantage or disadvantage over any other combination.

The yield of oats grown in an O-W-G rotation and the yields of oats in various other cropping systems are compared in table 6. The data presented here show very strikingly the disadvantage of following grass with oats. The percentage of gain in the grain yield from other rotations is higher than the percentage of gain in O-W-G in all plots, varying from 16.9 per cent to 41.7 per cent. The odds in favor of significance are high in practically all comparisons.

This rotation, O-W-G, fails to show any significant advantage as far as yield of oats is concerned, even when compared with oats grown continuously or alternately with wheat. If this rotation is compared carefully with the rotations differing from it in only one crop, the O-W-P and the O-W-C, then both potatoes and clover are far superior to grass to precede oats, regardless of the treatment of fertilizer or manure that the land may receive.

The straw yields in the untreated section A show no differences which are very significant, due to the large variations from year to year indicated by the large standard deviations. In section B the straw yields of oats in the rotations including clover are materially higher than the straw yields in the O-W-G rotation. In section C the straw yields in all the other cropping systems are higher than those in the O-W-G rotation.

The yield of oats grown in an O-G-P rotation and the yields of oats grown in various other cropping systems are compared in table 7. The O-G-P rotation, without question, produces a greater yield of oats than does the continuous-oats system or the O-W-G rotation; and so far as the data presented here are concerned, it is only slightly better than an O-W-O combination and is equal to O-W-C. When compared with the rotations O-W-P and O-C-P, which differ from it in only one crop; it equals O-W-P in yield of oats but is inferior to O-C-P by a slight margin varying from 7.9 to 14.7 per cent under the different treatments.

In the production of straw, the only rotations that surpassed O-G-P with any significance were the two which included clover. Although this advantage is always positive, it is not always significant.

The yield of oats grown in an O-W-C rotation and the yields of oats grown in various other cropping systems are compared in table 8. The advantage of using clover in a rotation to aid production of oats, over the use of grass, is well illustrated in this table. Also, it is important to note that there are no significant differences between this rotation and any other rotation in which oats follow potatoes, except where the rotation includes both clover and potatoes. This fact indicates plainly that the preparation of the seedbed has an important influence on the production of oats.

TABLE 4. COMPARISONS OF YIELD OF OATS GROWN IN AN O-W-O COMBINATION, WITH YIELDS OF OATS GROWN IN OTHER CROPPING SYSTEMS *

Section of plot	Combinations with which oats in O-W-O are compared	Yield of oats in O-W-O (pounds)	Yield of oats in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	O-O-O	3.619	3.171	−0.45	−12.4	0.971	0.46	14	15:1
	O-W-P	3.619	4.106	0.49	13.5	1.001	0.49	14	19:1
	O-W-G	3.763	3.112	−0.65	−17.3	1.215	0.53	13	21:1
	O-G-P	3.619	4.076	0.46	12.7	1.714	0.27	14	5:1
	O-W-C	3.619	4.084	0.46	12.7	1.918	0.24	14	4:1
	O-C-P	3.619	4.395	0.78	21.6	2.250	0.35	14	7:1
B	O-O-O	4.344	3.696	−0.65	−15.0	0.779	0.83	14	187:1
	O-W-P	4.344	4.806	0.46	10.6	0.800	0.57	14	32:1
	O-W-G	4.344	4.078	−0.27	− 6.2	1.283	0.21	14	3:1
	O-G-P	4.344	5.033	0.69	15.9	1.958	0.35	14	7:1
	O-W-C	4.344	4.764	0.42	9.7	1.412	0.30	14	6:1
	O-C-P	4.344	5.776	1.43	32.9	1.920	0.74	14	99:1
C	O-O-O	5.332	4.478	−0.85	−15.9	1.468	0.58	14	34:1
	O-W-P	5.332	5.935	0.60	11.3	1.010	0.59	14	37:1
	O-W-G	5.332	4.516	−0.82	−15.4	1.707	0.48	14	18:1
	O-G-P	5.332	5.499	0.17	3.2	1.716	0.10	14	2:1
	O-W-C	5.332	5.585	0.25	4.7	1.416	0.18	14	3:1
	O-C-P	5.332	6.230	0.90	16.9	1.731	0.52	14	23:1
				Straw					
A	O-O-O	7.342	6.575	−0.77	−10.5	2.063	0.37	12	7:1
	O-W-P	7.342	8.144	0.80	10.9	2.224	0.36	12	7:1
	O-W-G	7.726	7.177	−0.55	− 7.1	1.470	0.37	[illegible]	6:1
	O-G-P	7.342	7.402	0.06	0.8	2.947	0.02	12	<1:1
	O-W-C	7.342	8.815	1.47	20.0	4.700	0.31	12	5:1
	O-C-P	7.342	8.050	0.71	9.7	4.230	0.17	12	3:1

B	O-O-O........	9.683	7.804	−1 88	−19 4	2 441	0 77	12	73:1
	O-W-P.........	9.683	9.698	0.01	0.1	1.920	0 01	12	<1:1
	O-W-G.........	9 683	8.540	−1 14	−11.8	2 954	0.39	12	8:1
	O-G-P.........	9 683	9.154	−0.53	− 5.5	3.677	0.14	12	2:1
	O-W-C.........	9.683	10 614	0.93	9 6	3 579	0.26	12	4:1
	O-C-P.........	9 683	11.475	1.79	18.5	3.734	0.48	12	13:1
C	O-O-O.........	11.908	10.769	−1.14	− 9.6	2.204	0.52	12	17:1
	O-W-P.........	11.908	12.111	0.20	1.7	2.269	0.09	12	1:1
	O-W-G.........	11.908	9 379	−2.53	−21.2	2.194	1.15	12	666:1
	O-G-P.........	11.908	10 771	−1.14	− 9 6	3 252	0.35	12	6:1
	O-W-C.........	11 908	13.665	1.76	14.8	3.341	0.53	12	17:1
	O-C-P.........	11.908	12.217	0.31	2.6	3.720	0.08	12	1:1

* There is some duplication of data in this and in succeeding tables of data previously given. This is done in order that the yield of any crop in a given combination of crops can be compared directly with the yield of the same crop in all other combinations, as in table 3, without the necessity of referring to any other table.

TABLE 5. COMPARISONS OF YIELD OF OATS GROWN IN AN O-W-P COMBINATION, WITH YIELDS OF OATS GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which oats in O-W-P are compared	Yield of oats in O-W-P (pounds)	Yield of oats in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	O-O-O	4.106	3.171	−0.94	−22.9	0.744	1.26	14	3,565:1
	O-W-O	4.106	3.619	−0.49	−11.9	1.001	0.49	14	19:1
	O-W-G	4.249	3.112	−1.14	−26.8	1.267	0.90	13	226:1
	O-G-P	4.106	4.076	−0.03	−0.7	1.636	0.02	14	<1:1
	O-W-C	4.106	4.084	−0.02	−0.5	1.636	0.01	14	1:1
	O-C-P	4.106	4.395	0.29	7.1	1.998	0.15	14	2.1
B	O-O-O	4.806	3.696	−1.11	−23.1	0.577	1.92	14	>10,000:1
	O-W-O	4.806	4.344	−0.46	−9.6	0.800	0.57	14	32:1
	O-W-G	4.806	4.078	−0.73	−15.2	1.253	0.58	14	34:1
	O-G-P	4.806	5.033	0.23	4.8	1.828	0.13	14	2:1
	O-W-C	4.806	4.764	−0.04	−0.8	1.160	0.03	14	<1.1
	O-C-P	4.806	5.776	0.97	20.2	1.787	0.54	14	25:1
C	O-O-O	5.935	4.478	−1.46	−24.6	1.468	0.99	14	582:1
	O-W-O	5.935	5.332	−0.60	−10.1	1.010	0.59	14	37:1
	O-W-G	5.935	4.516	−1.42	−23.9	1.238	1.15	14	1,666:1
	O-G-P	5.935	5.499	−0.44	−7.4	1.196	0.37	14	9:1
	O-W-C	5.935	5.585	−0.35	−5.9	1.379	0.25	14	4:1
	O-C-P	5.935	6.230	0.29	4.9	1.253	0.23	14	4:1
				Straw					
A	O-O-O	8.144	6.575	−1.57	−19.3	2.267	0.69	12	46:1
	O-W-O	8.144	7.342	−0.80	−9.8	2.224	0.36	12	7:1
	O-W-G	8.539	7.177	−1.36	−15.9	2.383	0.57	11	19:1
	O-G-P	8.144	7.402	−0.74	−9.1	3.223	0.23	12	8:1
	O-W-C	8.144	8.815	0.67	8.2	4.275	0.16	12	2:1
	O-C-P	8.144	8.050	−0.09	−1.1	3.870	0.02	12	<1:1

B	O-O-O . . .	9 698	7 804	−1 89	−19 5	1.557	1.21	12	948.1
	O-W-O . . .	9 698	9 683	−0 01	− 0 1	1 920	0 01	12	< [illegible]
	O-W-G. . . .	9 698	8 540	−1.16	−12 0	2 615	0 44	12	10 1
	O-G-P.	9.698	9.154	−0.54	− 5 6	3 341	0.16	12	2 1
	O-W-C.	9 698	10 614	0 92	9.5	3 052	0 30	12	5.1
	O-C-P.	9.698	11 475	1 78	18.4	3.712	0 48	12	13:1
C	O-O-O.	12 111	10 769	−1.34	−11.1	1 997	0 67	12	40:1
	O-W-O.	12 111	11 908	−0 20	− 1.7	2 269	0 09	12	1·1
	O-W-G.	12.111	9 379	−2 73	−22.5	2 231	1 22	12	989 1
	O-G-P.	12 111	10 771	−1 34	−11.1	2 981	0 45	12	11.1
	O-W-C.	12 111	13.665	1.55	12.8	3 615	0 43	12	10 1
	O-C-P . . .	12 111	12 217	0 11	0 9	3 498	0 03	12	< 1 1

TABLE 6. COMPARISONS OF YIELD OF OATS GROWN IN AN O-W-G COMBINATION, WITH YIELDS OF OATS GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which oats in O-W-G are compared	Yield of oats in O-W-G (pounds)	Yield of oats in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	O-O-O	3 112	3.230	0 12	3 9	1.190	0 10	13	2 1
	O-W-O	3.112	3.763	0 65	20.9	1.215	0 53	13	21.1
	O-W-P	3.112	4 249	1 14	36.6	1.267	0.90	13	226 1
	O-G-P	3 112	4 136	1.02	32.8	1.074	0 95	13	293:1
	O-W-C	3 112	4.175	1.06	34.1	1.722	0.62	13	36·1
	O-C-P	3.112	4.372	1 26	40.5	1.820	0 69	13	58 1
B	O-O-O	4.078	3 696	−0.38	− 9.3	1.061	0.36	14	8·1
	O-W-O	4.078	4.344	0.27	6.6	1.283	0 21	14	3:1
	O-W-P	4.078	4.806	0.73	17.9	1 253	0.58	14	34·1
	O-G-P	4 078	5 033	0.95	23 3	1.034	0 92	14	353·1
	O-W-C	4 078	4.764	0 69	16 9	1.370	0.50	14	20 1
	O-C-P	4.078	5.776	1 70	41 7	1 447	1.17	14	1,999 1
C	O-O-O	4.516	4 478	−0.04	− 0 9	1.593	0.03	14	<1·1
	O-W-O	4.516	5.332	0.82	18.2	1.707	0.48	14	18.1
	O-W-P	4 516	5.935	1.42	31.4	1.238	1 15	14	1,666 1
	O-G-P	4 516	5 499	0 98	21.7	1 002	0 98	14	541·1
	O-W-C	4 516	5.585	1 07	23 7	1 338	0.80	14	158·1
	O-C-P	4.516	6.230	1.71	37.9	1.509	1.13	14	1,499·1
				Straw					
A	O-O-O	7.177	6.741	−0.44	− 6.1	2.351	0.19	11	3:1
	O-W-O	7.177	7.726	0 55	7.7	1.470	0.37	11	6·1
	O-W-P	7.177	8.539	1.36	18.9	2 383	0.57	11	19.1
	O-G-P	7.177	7.544	0.37	5.2	1.828	0.20	11	3:1
	O-W-C	7.177	9.157	1.98	27.6	4.532	0.44	11	9·1
	O-C-P	7.177	8.045	0 87	12.1	3.546	0.25	11	3·1

B	O-O-O	8.540	7 804	−0 74	− 8 7	2 136	0.35	12	6 1
	O-W-O	8.540	9 683	1 14	13 3	2.954	0.39	12	8·1
	O-W-P	8.540	9 698	1 16	13 6	2 615	0 44	12	10:1
	O-G-P	8 540	9 154	0 61	7 1	2 018	0.30	12	5:1
	O-W-C	8 540	10.614	2 07	24.2	2 610	0 79	12	83:1
	O-C-P	8 540	11 475	2 93	34.3	2 825	1.04	12	354:1
C	O-O-O	9 379	10 769	1.39	14 8	1 973	0.70	12	48.1
	O-W-O	9 379	11 908	2 53	27 0	2.194	1.15	12	666·1
	O-W-P	9 379	12 111	2.73	29 1	2 231	1.22	12	989:1
	O-G-P	9 379	10.771	1 39	14 8	2.472	0.56	12	21.1
	O-W-C	9 379	13 665	4 29	45 7	3 100	1.38	12	2,799 1
	O-C-P	9 379	12 217	2.84	30 3	2 698	1 05	12	369·1

TABLE 7. COMPARISONS OF YIELD OF OATS GROWN IN AN O-G-P COMBINATION, WITH YIELDS OF OATS GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which oats in O-G-P are compared	Yield of oats in O-G-P (pounds)	Yield of oats in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	O-O-O	4 076	3 171	−0 91	−22.3	1 544	0 59	14	37·1
	O-W-O	4 076	3 619	−0 46	−11 3	1 714	0 27	14	5 1
	O-W-P	4 076	4 106	0 03	0 7	1 636	0 02	14	<1:1
	O-W-G	4 136	3 112	−1 02	−24 7	1 074	0 95	13	293·1
	O-W-C	4 076	4 084	0 01	0 2	1 559	0 01	14	<1 1
	O-C-P	4 076	4 395	0 32	7 9	1 069	0 30	14	6·1
B	O-O-O	5 033	3 696	−1 34	−26 6	1 714	0 78	14	136·1
	O-W-O	5 033	4 344	−0 69	−13 7	1 958	0 35	14	7 1
	O-W-P	5 033	4 806	−0 23	− 4 6	1 828	0 13	14	2:1
	O-W-G	5·033	4 078	−0 95	−18 9	1 034	0 92	14	353:1
	O-W-C	5 033	4 764	−0 27	− 5 4	1 692	0 16	14	2:1
	O-C-P	5 033	5 776	0 74	14 7	1 074	0 69	14	73:1
C	O-O-O	5·499	4 478	−1 02	−18.5	1 495	0 68	14	67.1
	O-W-O	5 499	5·332	−0 17	− 3 1	1 716	0 10	14	2:1
	O-W-P	5·499	5 935	0 44	8.0	1 196	0 37	14	9·1
	O-W-G	5·499	4 516	−0 98	−17 8	1.002	0 98	14	541 1
	O-W-C	5 499	5 585	0 09	1 6	1 093	0 08	14	1:1
	O-C-P	5 499	6.230	0 73	13 3	1.316	0 55	14	27.1
				Straw					
A	O-O-O	7 402	6.575	−0 83	−11 2	3.312	0 25	12	4:1
	O-W-O	7 402	7·342	−0.06	− 0.8	2.947	0.02	12	<1:1
	O-W-P	7·402	8 144	0.74	10 0	3 223	0 23	12	3:1
	O-W-G	7·544	7 177	−0 37	− 4.9	1.828	0 20	11	3:1
	O-W-C	7 402	8.815	1.41	19.0	3.727	0 38	12	8 1
	O-C-P	7·402	8 050	0.65	8.8	2.248	0 29	12	5:1

B	O-O-O	9 154	7.804	−1.35	−14.7	2 948	0.46	12	12:1
	O-W-O	9.154	9 683	0.53	5.8	3.677	0.14	12	2 1
	O-W-P	9.154	9 698	0 54	5 9	3.341	0.16	12	2:1
	O-W-G	9.154	8.540	−0 61	− 6 7	2.018	0.30	12	5:1
	O-W-C	9.154	10 614	1.46	15 9	3 086	0.47	12	12:1
	O-C-P	9.154	11 475	2.32	25.3	2.238	1 04	12	354 1
C	O-O-O	10.771	10.769	0.0	0.0	2.337	0.0	12	<1:1
	O-W-O	10.771	11.908	1.14	10.6	3.252	0.35	12	6.1
	O-W-P	10.771	12.111	1.34	12 4	2.981	0.45	12	11:1
	O-W-G	10.771	9 379	−1.39	−12 9	2.472	0 56	12	31:1
	O-W-C	10.771	13.665	2.89	26 8	3.217	0.90	12	160:1
	O-C-P	10.771	12.217	1.45	13.5	2 552	0.57	12	22.1

TABLE 8. COMPARISONS OF YIELD OF OATS GROWN IN AN O-W-C COMBINATION, WITH YIELDS OF OATS GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which oats in O-W-C are compared	Yield of oats in O-W-C (pounds)	Yield of oats in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	O-O-O	4.084	3 171	−0 91	−22.3	1.700	0.54	14	25:1
	O-W-O	4.084	3.619	−0 46	−11 3	1 918	0 24	14	4:1
	O-W-P	4.084	4.106	0.02	0 5	1 636	0 01	14	<1:1
	O-W-G	4 175	3.112	−1.06	−25.4	1 722	0 62	13	36·1
	O-G-P	4 084	4 076	−0.01	− 0 2	1 559	0 01	14	<1:1
	O-C-P	4 084	4 395	0 31	7 6	1.285	0.24	14	4.1
B	O-O-O	4.764	3 696	−1 07	−22 5	0.963	1 11	14	1,332:1
	O-W-O	4.764	4.344	−0 42	− 8 8	1.412	0 30	14	6:1
	O-W-P	4.764	4.806	0.04	0 8	1 160	0.03	14	<1:1
	O-W-G	4.764	4 078	−0 69	−14 5	1 370	0 50	14	20:1
	O-G-P	4.764	5.033	0.27	5 7	1 692	0.16	14	2.1
	O-C-P	4.764	5.776	1 01	21 2	1.697	0.60	14	39·1
C	O-O-O	5.585	4.478	−1 11	−19 9	1 454	0 76	14	115:1
	O-W-O	5.585	5 332	−0.25	− 4.5	1 416	0.18	14	3:1
	O-W-P	5.585	5.935	0.35	6 3	1.379	0 25	14	4.1
	O-W-G	5.585	4.516	−1 07	−19.2	1.338	0.80	14	158:1
	O-G-P	5.585	5.499	−0.09	− 1 6	1 093	0.08	14	1:1
	O-C-P	5.585	6.230	0.64	11 5	2.017	0.32	14	6·1
				Straw					
A	O-O-O	8.815	6.575	−2.24	−25 4	4.562	0.49	12	14:1
	O-W-O	8.815	7.342	−1.47	−16.7	4.700	0.31	12	5.1
	O-W-P	8.815	8.144	−0.67	− 7.6	4.275	0.16	12	2.1
	O-W-G	9.157	7.177	−1.98	−21.6	4.532	0.44	11	9 1
	O-G-P	8.815	7.402	−1.41	−16.0	3.727	0.38	12	8:1
	O-C-P	8.815	8.050	−0.76	− 8.6	2.778	0.27	12	4 [illegible]

B	O-O-O.........	10.614	7.804	−2 81	−26 5	2.448	1.15	12	666:1
	O-W-O.........	10.614	9.683	−0.93	− 8.8	3.579	0.26	12	4:1
	O-W-P.........	10.614	9 698	−0.92	− 8.7	3.052	0.30	12	5:1
	O-W-G.........	10.614	8.540	−2.07	−19.5	2.610	0.79	12	83:1
	O-G-P.........	10.614	9 154	−1.46	−13.8	3 086	0.47	12	12:1
	O-C-P.........	10.614	11.475	0.86	8.1	3.072	0.28	12	4:1
C	O-O-O.........	13.665	10.769	−2.90	−21.2	3.193	0 91	12	169:1
	O-W-O.........	13.665	11 908	−1.76	−12.9	3.341	0.53	12	17:1
	O-W-P.........	13.665	12 111	−1.55	−11.3	3.615	0.43	12	10:1
	O-W-G.........	13 665	9 379	−4.29	−31.4	3.100	1.38	12	2,799:1
	O-G-P.........	13.665	10.771	−2.89	−21.1	3.217	0.90	12	160:1
	O-C-P.........	13.665	12.217	−1.45	−10.6	4 104	0 35	12	6:1

TABLE 9. COMPARISONS OF YIELD OF OATS GROWN IN AN O-C-P COMBINATION, WITH YIELDS OF OATS GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which oats in O-C-P are compared	Yield of oats in O-C-P (pounds)	Yield of oats in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	O-O-O	4.395	3.171	−1.22	−27.8	1.922	0.63	14	47:1
	O-W-O	4.395	3.619	−0.78	−17.7	2.250	0.35	14	7:1
	O-W-P	4.395	4.106	−0.29	−6.6	1.998	0.15	14	2:1
	O-W-G	4.372	3.112	−1.26	−28.8	1.820	0.69	13	58:1
	O-G-P	4.395	4.076	−0.32	−7.3	1.069	0.30	14	6:1
	O-W-C	4.395	4.084	−0.31	−7.1	1.285	0.24	14	4:1
B	O-O-O	5.776	3.696	−2.08	−36.0	1.664	1.25	14	3,332:1
	O-W-O	5.776	4.344	−1.43	−24.8	1.920	0.74	14	99:1
	O-W-P	5.776	4.806	−0.97	−16.8	1.787	0.54	14	25:1
	O-W-G	5.776	4.078	−1.70	−29.4	1.447	1.17	14	1,999:1
	O-G-P	5.776	5.033	−0.74	−12.8	1.074	0.69	14	73:1
	O-W-C	5.776	4.764	−1.01	−17.5	1.697	0.60	14	39:1
C	O-O-O	6.230	4.478	−1.75	−28.1	1.700	1.03	14	749:1
	O-W-O	6.230	5.332	−0.90	−14.4	1.731	0.52	14	23:1
	O-W-P	6.230	5.935	−0.29	−4.7	1.253	0.23	14	4:1
	O-W-G	6.230	4.516	−1.71	−27.4	1.509	1.13	14	1,499:1
	O-G-P	6.230	5.499	−0.73	−11.7	1.316	0.55	14	27:1
	O-W-C	6.230	5.585	−0.64	−10.3	2.017	0.32	14	6:1
				Straw					
A	O-O-O	8.050	6.575	−1.47	−18.3	4.072	0.36	12	7:1
	O-W-O	8.050	7.342	−0.71	−8.8	4.230	0.17	12	2:1
	O-W-P	8.050	8.144	0.09	1.1	3.870	0.02	12	<1:1
	O-W-G	8.045	7.177	−0.87	−10.8	3.546	0.25	11	3:1
	O-G-P	8.050	7.402	−0.65	−8.1	2.248	0.29	12	5:1
	O-W-C	8.050	8.815	0.76	9.4	2.778	0.27	12	4:1

B	O-O-O	11.475	7.804	−3.67	−32.0	3.001	1.22	12	989:1
	O-W-O	11.475	9.683	−1.79	−15.6	3.734	0.48	12	13:1
	O-W-P	11.475	9.698	−1.78	−15.5	3.712	0.48	12	13:1
	O-W-G	11.475	8.540	−2.93	−25.5	2 817	1.04	12	354:1
	O-G-P	11.475	9.154	−2.32	−20.2	2.238	1.04	12	354:1
	O-W-C	11.475	10.614	−0.86	− 7.5	3.072	0.28	12	4:1
C	O-O-O	12.217	10 769	−1.45	−11.9	2.485	0.58	12	24.1
	O-W-O	12.217	11.908	−0.31	− 2.5	3.720	0.08	12	1:1
	O-W-P	12 217	12.111	−0.11	− 0.9	3.498	0.03	12	<1:1
	O-W-G	12 217	9 379	−2.84	−23.2	2.698	1.05	12	369:1.
	O-G-P	12.217	10.771	−1.45	−11.9	2.552	0.57	12	22.1
	O-W-C	12 217	13 665	1 45	11.9	4 104	0.35	12	6:1

It would hardly be disputed that a better seedbed for oats can be prepared with the same amount of labor from one that has had potatoes than from one that has had either clover or grass.

The straw production of oats grown after clover and without treatment is from 7.6 to 25.4 per cent greater than it is after any other crop. However, due to the large standard deviation the odds are low. With fertilizer and with fertilizer and manure some of the differences are highly significant, although not much greater in percentage. There is only one exception in this table to the general rule of positive differences in favor of the O-W-C rotation over all other systems included here for production of oats straw. The one comparatively small exception occurs in the O C-P rotation.

The yield of oats grown in an O-C-P rotation is compared with the yields of oats grown in various other cropping systems in table 9. All things considered, the rotation O-C-P is probably the best of those included in this experiment for obtaining a large production of oats. The average production of grain is from 4.7 per cent to 36.0 per cent higher in this rotation than it is in the other systems, while the odds in favor of these differences being significant are comparatively high with one or more treatments in each instance. The combinations most nearly approaching the O-C-P rotation for production of oats are the O-W-C and O-W-P rotations.

In the production of oats straw, the O-C-P rotation is surpassed only by the O-W-C rotation. The difference is very small. Furthermore, there is no significant difference between the O-C-P rotation and the O-W-O and O-W-P combinations in the production of straw.

Comparisons of wheat grown in various combinations are presented in tables 10 to 14 in the same way in which the yields of oats are compared in tables 3 to 9. The yield of wheat grown continuously is compared with the yields of wheat grown in various other cropping systems in table 10. In the study of the grain yields it is noted that no significant difference exists, so far as these data are concerned, between wheat grown continuously and wheat grown either alternately with oats or in the O-W-G combination. However, since the differences are all positive except one, they do indicate that continuous cropping of wheat is the poorest system possible for producing that crop. When compared directly with O-W-P, the percentage differences are 10.2, 15.7, and 29.0, the 29.0 per cent being highly significant. The increased yield of wheat in the O-W-C rotation over that of continuous wheat varies from 19.5 per cent to 34.6 per cent. It is interesting to compare the yield of wheat in the O-W-G rotation with the yield of continuous wheat, together with the results of oats in the same rotation compared with oats grown continuously. In neither instance was the rotation significantly better, regardless of the fertilizer or manurial treatment. The details of the annual yields indicate, however, that had the experiment continued for a greater number of years there might have developed a significant difference in the production of both oats and wheat. The yields for the last three years show somewhat larger differences in favor of the oats and wheat in the rotation, over the same crops in continuous culture.

TABLE 10. COMPARISONS OF YIELD OF WHEAT GROWN CONTINUOUSLY, WITH YIELDS OF WHEAT GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Rotations with which continuous wheat is compared	Yield of continuous wheat (pounds)	Yield of wheat in rotations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	O-W-O	3.179	3.162	−0.02	−0.6	1.458	0.01	12	<1:1
	O-W-P	3.032	3.346	0.31	10.2	1.565	0.20	11	3:1
	O-W-G	3.179	3.402	0.22	6.9	1.473	0.15	12	2:1
	O-W-C	3.179	3.801	0.62	19.5	1.884	0.33	12	6:1
B	O-W-O	3.883	4.454	0.57	14.7	2.144	0.27	12	4:1
	O-W-P	3.883	4.496	0.61	15.7	1.431	0.43	12	10:1
	O-W-G	3.883	4.321	0.44	11.3	1.547	0.28	12	4:1
	O-W-C	3.883	5.215	1.33	34.3	1.549	0.86	12	123:1
C	O-W-O	4.652	5.615	0.96	20.6	1.922	0.50	12	15:1
	O-W-P	4.652	6.000	1.35	29.0	1.462	0.92	12	179:1
	O-W-G	4.652	4.990	0.34	7.3	1.554	0.22	12	3:1
	O-W-C	4.652	6.259	1.61	34.6	1.296	1.24	12	1,070:1
				Straw					
A	O-W-O	8.065	8.750	0.68	8.4	2.490	0.27	10	4:1
	O-W-P	8.006	8.401	0.40	5.0	2.470	0.16	9	2:1
	O-W-G	8.065	7.753	−0.31	−3.8	3.088	0.10	10	2:1
	O-W-C	8.065	9.296	1.23	15.3	3.513	0.35	10	5:1
B	O-W-O	9.535	10.640	1.10	11.5	3.418	0.32	10	4:1
	O-W-P	9.535	9.670	0.13	1.4	2.166	0.06	10	1:1
	O-W-G	9.535	8.626	−0.91	−9.5	1.946	0.47	10	9:1
	O-W-C	9.535	11.038	1.50	15.7	2.887	0.52	10	12:1
C	O-W-O	12.203	13.193	0.99	8.1	4.066	0.24	10	3:1
	O-W-P	12.203	13.165	0.96	7.9	2.902	0.33	10	5:1
	O-W-G	12.203	10.758	−1.44	−11.8	4.042	0.36	10	5:1
	O-W-C	12.203	13.431	1.23	10.1	2.826	0.44	10	8:1

There are no clearly significant differences in the straw yields as judged by the odds. However, with one exception the yields of straw are less in the continuous system than in the other systems. The exception. O-W-G, gives negative differences in all sections.

The yield of wheat grown in an O-W-O combination is compared with the yields of wheat grown in various other cropping systems in table 11. Wheat grown alternately with oats yielded more grain in sections B and C than wheat in either the W-W-W or the O-W-G systems, but it was outyielded by the wheat in both the O-W-P and the O-W-C combinations. The differences were rather small in all comparisons, with high standard deviations, causing the odds to be low and consequently insignificant. The O-W-O system outyielded in wheat straw all systems except O-W-C; even here it was surpassed only slightly. The only significant difference is shown in sections B and C in the O-W-G combination. In these instances the yields are 18.5 per cent and 18.9 per cent less than in those where wheat is grown alternately with oats.

The yield of wheat grown in an O-W-P rotation and the yields of wheat grown in various other cropping systems are compared in table 12. Wheat in this rotation outyields in both grain and straw the wheat grown continuously, the percentages varying from 1.3 to 22.5. The odds, however, are small except for grain yields in section C. The other point of interest is that wheat under all treatments in this rotation outyielded the wheat under all treatments in the O-W-G rotation in both grain and straw yields, with the exception of the grain yields in section A, the percentage varying from 3.5 to 18.3. The odds are low, as above, except for the grain and straw yields in section C.

The yield of wheat grown in an O-W-G rotation and the yields of wheat grown in various other cropping systems are compared in table 13. The yield of wheat, as also the yield of oats already shown, is poor in this rotation in comparison with wheat in all other systems except in the continuous wheat plots and in the grain yields of section A of the O-W-O and O-W-P systems. Even here the differences in yields in all cases are very small and insignificant, since the greatest odds are 9:1. The O-W-G gave slightly greater wheat grain yields and slightly smaller straw yields than did the W-W-W system.

When the O-W-C and the O-W-P rotations are considered under all conditions, they show a distinct advantage over the O-W-G rotation in the production of wheat. This difference is, however, not significant in either grain or straw in the untreated sections.

The yield of wheat grown in an O-W-C rotation and the yields of wheat grown in various other cropping systems are compared in table 14. Wheat in this rotation without exception outyields wheat in all the other systems. The differences in favor of O-W-C in the yield of grain vary from 4.2 per cent in section C of O-W-P to 25.7 per cent in section C of W-W-W. Significant odds are found in comparing O-W-C with W-W-W and O-W-G.

The differences in favor of O-W-C in the yield of straw vary from 1.8 per cent in section C of O-W-O to 21.8 per cent in section B of O-W-G. The only significant odds, however, are found in section B, in which O-W-G compared with O-W-C gives odds of 358:1 in favor of O-W-C.

TABLE 11. COMPARISONS OF YIELD OF WHEAT GROWN IN AN O-W-O COMBINATION, WITH YIELDS OF WHEAT GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which wheat in O-W-O is compared	Yield of wheat in O-W-O (pounds)	Yield of wheat in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	W-W-W	3.162	3.179	0.02	0.6	1.458	0.01	12	<1:1
	O-W-P	2.941	3.346	0.41	13.9	1.039	0.39	11	7:1
	O-W-G	3.162	3.402	0.24	7.6	1.553	0.15	12	2:1
	O-W-C	3.162	3.801	0.64	20.2	2.009	0.32	12	5:1
B	W-W-W	4.454	3.883	−0.57	−12.8	2.144	0.27	12	4:1
	O-W-P	4.454	4.496	0.04	0.9	1.515	0.03	12	1:1
	O-W-G	4.454	4.321	−0.13	−2.9	2.424	0.05	12	1:1
	O-W-C	4.454	5.215	0.76	17.1	2.367	0.32	12	5:1
C	W-W-W	5.615	4.652	−0.96	−17.1	1.922	0.50	12	15:1
	O-W-P	5.615	6.000	0.38	6.8	1.217	0.31	12	5:1
	O-W-G	5.615	4.990	−0.62	−11.0	1.753	0.35	12	6:1
	O-W-C	5.615	6.259	0.64	11.4	1.526	0.42	12	9:1
				Straw					
A	W-W-W	8.750	8.065	−0.68	−7.8	2.490	0.27	10	4:1
	O-W-P	8.678	8.401	−0.28	−3.2	0.984	0.28	9	4:1
	O-W-G	8.750	7.753	−1.00	−11.4	1.946	0.51	10	11:1
	O-W-C	8.750	9.296	0.55	6.3	3.805	0.14	10	2:1
B	W-W-W	10.640	9.535	−1.10	−10.3	3.418	0.32	10	4:1
	O-W-P	10.640	9.670	−0.97	−9.1	1.593	0.61	10	19:1
	O-W-G	10.640	8.626	−2.01	−18.9	3.055	0.66	10	24:1
	O-W-C	10.640	11.038	0.40	3.8	4.032	0.10	10	2:1
C	W-W-W	13.193	12.203	−0.99	−7.5	4.066	0.24	10	3:1
	O-W-P	13.193	13.165	−0.03	−0.2	3.251	0.01	10	<1:1
	O-W-G	13.193	10.758	−2.44	−18.5	3.308	0.74	10	36:1
	O-W-C	13.193	13.431	0.24	1.8	3.197	0.08	10	1:1

TABLE 12. COMPARISONS OF YIELD OF WHEAT GROWN IN AN O-W-P COMBINATION, WITH YIELDS OF WHEAT GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which wheat in O-W-P is compared	Yield of wheat in O-W-P (pounds)	Yield of wheat in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	W-W-W	3.346	3.032	−0.31	− 9.3	1.565	0.20	11	3:1
	O-W-O	3.346	2.941	−0.41	−12.3	1.039	0.39	11	7:1
	O-W-G	3.346	3.521	0.17	5.1	1.525	0.11	11	2:1
	O-W-C	3.346	3.965	0.62	18.5	1.969	0.31	11	5:1
B	W-W-W	4.496	3.883	−0.61	−13.6	1.431	0.43	12	10:1
	O-W-O	4.496	4.454	−0.04	− 0.9	1.515	0.03	12	<1:1
	O-W-G	4.496	4.321	−0.17	− 3.8	1.172	0.15	12	2:1
	O-W-C	4.496	5.215	0.72	16.0	1.338	0.54	12	18:1
C	W-W-W	6.000	4.652	−1.35	−22.5	1.462	0.92	12	179:1
	O-W-O	6.000	5.615	−0.38	− 6.3	1.217	0.31	12	5:1
	O-W-G	6.000	4.990	−1.01	−16.8	1.037	0.97	12	241:1
	O-W-C	6.000	6.259	0.26	4.3	0.991	0.26	12	4:1
				Straw					
A	W-W-W	8.401	8.006	−0.40	− 4.8	2.470	0.16	9	2:1
	O-W-O	8.401	8.678	0.28	3.3	0.984	0.28	9	4:1
	O-W-G	8.401	8.114	−0.29	− 3.5	2.015	0.14	9	2:1
	O-W-C	8.401	9.707	1.31	15.6	3.673	0.36	9	5:1
B	W-W-W	9.670	9.535	−0.13	− 1.3	2.166	0.06	10	1:1
	O-W-O	9.670	10.640	0.97	10.0	1.593	0.61	10	18:1
	O-W-G	9.670	8.626	−1.04	−10.8	1.854	0.56	10	14:1
	O-W-C	9.670	11.038	1.37	14.2	2.922	0.47	10	9:1
C	W-W-W	13.165	12.203	−0.96	− 7.3	2.902	0.33	10	5:1
	O-W-O	13.165	13.193	0.03	0.2	3.251	0.01	10	<1:1
	O-W-G	13.165	10.758	−2.41	−18.3	3.033	0.79	10	47:1
	O-W-C	13.165	13.431	0.27	2.1	4.022	0.07	10	1:

TABLE 13. COMPARISONS OF YIELD OF WHEAT GROWN IN AN O-W-G COMBINATION, WITH YIELDS OF WHEAT GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which wheat in O-W-G is compared	Yield of wheat in O-W-G (pounds)	Yield of wheat in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	W-W-W........	3.402	3.179	−0.22	−6.5	1.473	0.15	12	2:1
	O-W-O......	3.402	3.162	−0.24	−7.1	1.553	0.15	12	2:1
	O-W-P.... ...	3.521	3.346	−0.17	−4.8	1.525	0.11	11	2:1
	O-W-C.	3.402	3.801	0.40	11.8	1.407	0.28	12	4:1
B	W-W-W..	4.321	3.883	−0.44	−10.2	1.547	0.28	12	4:1
	O-W-O.. ..	4.321	4.454	0.13	3.0	2.424	0.05	12	1:1
	O-W-P.......	4.321	4.496	0.17	3.9	1.172	0.15	12	2:1
	O-W-C... ...	4.321	5.215	0.89	20.6	0.825	1.08	12	463:1
C	W-W-W..	4.990	4.652	−0.34	−6.8	1.554	0.22	12	3:1
	O-W-O	4.990	5.615	0.62	12.4	1.753	0.35	12	6:1
	O-W-P..	4.990	6.000	1.01	20.2	1.037	0.97	12	241:1
	O-W-C.	4.990	6.259	1.27	25.5	1.114	1.14	12	638:1
				Straw					
A	W-W-W..	7.753	8.065	0.31	4.0	3.088	0.10	10	2:1
	O-W-O.... ...	7.753	8.750	1.00	12.9	1.946	0.51	10	11:1
	O-W-P..	8.114	8.401	0.29	3.6	2.015	0.14	9	2:1
	O-W-C......	7.753	9.296	1.54	19.9	2.779	0.55	10	14:1
B	W-W-W.. ..	8.626	9.535	0.91	10.5	1.946	0.47	10	9:1
	O-W-O........	8.626	10.640	2.01	23.3	3.055	0.66	10	24:1
	O-W-P...... ..	8.626	9.670	1.04	12.1	1.854	0.56	10	14:1
	O-W-C........	8.626	11.038	2.41	27.9	1.996	1.21	10	358:1
C	W-W-W........	10.758	12.203	1.44	13.4	4.042	0.36	10	5:1
	O-W-O.......	10.758	13.193	2.44	22.7	3.308	0.74	10	36:1
	O-W-P... ..	10.758	13.165	2.41	22.4	3.033	0.79	10	47:1
	O-W-C..	10.758	13.431	2.67	24.8	4.114	0.65	10	22:1

TABLE 14. COMPARISONS OF YIELD OF WHEAT IN AN O-W-C COMBINATION, WITH YIELDS OF WHEAT GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which wheat in O-W-C is compared	Yield of wheat in O-W-C (pounds)	Yield of wheat in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain					
A	W-W-W........	3.801	3.179	−0.62	−16.3	1.884	0.33	12	6:1
	O-W-O........	3.801	3.162	−0.64	−16.8	2.009	0.32	12	5:1
	O-W-P........	3.965	3.346	−0.62	−15.6	1.969	0.31	11	5:1
	O-W-G........	3.801	3.402	−0.40	−10.5	1.407	0.28	12	4:1
B	W-W-W........	5.215	3.883	−1.33	−25.5	1.549	0.86	12	123:1
	O-W-O........	5.215	4.454	−0.76	−14.6	2.367	0.32	12	5:1
	O-W-P........	5.215	4.496	−0.72	−13.8	1.338	0.54	12	18:1
	O-W-G........	5.215	4.321	−0.89	−17.1	0.825	1.08	12	463:1
C	W-W-W........	6.259	4.652	−1.61	−25.7	1.296	1.24	12	1,070:1
	O-W-O........	6.259	5.615	−0.64	−10.2	1.526	0.42	12	9:1
	O-W-P........	6.259	6.000	−0.26	− 4.2	0.991	0.26	12	4:1
	O-W-G........	6.259	4.990	−1.27	−20.3	1.114	1.14	12	638:1
				Straw					
A	W-W-W........	9.296	8.065	−1.23	−13.2	3.513	0.35	10	5:1
	O-W-O........	9.296	8.750	−0.55	− 5.9	3.805	0.14	10	2:1
	O-W-P........	9.707	8.401	−1.31	−13.5	3.673	0.36	9	5:1
	O-W-G........	9.296	7.753	−1.54	−16.6	2.779	0.55	10	14:1
B	W-W-W........	11.038	9.535	−1.50	−13.6	2.887	0.52	10	12:1
	O-W-O........	11.038	10.640	−0.40	− 3.6	4.032	0.10	10	2:1
	O-W-P........	11.038	9.670	−1.37	−12.4	2.922	0.47	10	9:1
	O-W-G........	11.038	8.626	−2.41	−21.8	1.996	1.21	10	358:1
C	W-W-W........	13.431	12.203	−1.23	− 9.2	2.826	0.44	10	8:1
	O-W-O........	13.431	13.193	−0.24	− 1.8	3.197	0.08	10	1:1
	O-W-P........	13.431	13.165	−0.27	− 2.0	4.022	0.07	10	1:1
	O-W-G........	13.431	10.758	−2.67	−19.9	4.114	0.65	10	22:1

The yield of potatoes grown continuously and of potatoes grown in various rotations are compared in table 15. The difference between the yield of potatoes grown continuously on the same land and of potatoes grown in any rotation is so great that the calculation of odds usually becomes unnecessary, even though the standard deviation is high. The comparisons in this table show that the advantage of potatoes in a rotation over continuous potatoes is never less than 50 per cent. The smallest difference is found in O-W-P, but even there the average percentage for the three sections is 58, with very high odds.

The figures, striking as they are, fail to show the actual differences existing between the plots. In the first place, although clean seed was used, scab was very prevalent in the continuous potato plots. This fact always made marketable potatoes scarce in the continuous potato plots. Scab was entirely absent from the potatoes grown on the rotated plots. The size of the tubers, as well as their smoothness and uniformity, was also in favor of the potatoes grown in rotation. Perfect stands were readily secured following grain, clover, or grass, but were difficult to secure under continuous-culture conditions.

The physical character of the soil also changed when potatoes were grown continuously year after year, a condition which probably would result with any cultivated crop grown continuously. The surface of the soil became somewhat lower than the plots on either side, the organic matter was depleted, and the soil ran together badly, so that proper fitting was difficult. The manure on section C overcame these physical difficulties to a considerable extent, but, on the other hand, it tended to increase the amount of scab.

The yield of potatoes grown in an O-W-P rotation and the yields of potatoes grown in other cropping systems are compared in table 16. This rotation is distinctly better for potato production than P-P-P, but not so good as either O-G-P or O-C-P. The odds in favor of the last two are significant only in section B, but they are positive in three out of the other four comparisons. Either a clover or a grass crop in a rotation seems therefore beneficial to the production of potatoes.

The yield of potatoes grown in an O-G-P rotation and the yields of potatoes grown in other cropping systems are compared in table 17. In each comparison, potatoes yield more than in either the P-P-P or the O-W-P system, except in section C in which O-W-P shows a 4.3-per-cent advantage with small odds.

The yield of potatoes grown in an O-C-P rotation and the yields of potatoes grown in other cropping systems are compared in table 18. Potatoes in this rotation outyielded potatoes in all the other systems without exception. Although the percentage differences and the odds are small in some cases, they are nevertheless positive. The differences in favor of this rotation for potatoes vary from 5.3 per cent to 45.3 per cent. When all the facts are considered, this rotation seems best for the production of potatoes, so far as the systems included in this test are concerned. It will be recalled in this connection that this rotation also gave the best yield of oats of any rotation including oats used in this test.

TABLE 15. COMPARISONS OF YIELD OF POTATOES GROWN CONTINUOUSLY, WITH YIELDS OF POTATOES GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Rotations with which continuous potatoes are compared	Yield of continuous potatoes (pounds)	Yield of potatoes in rotations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
A	O-W-P	21.179	33.537	12.36	58.4	16.011	0.77	12	73:1
	O-G-P	21.179	36.958	15.78	74.5	11.150	1.42	12	3,332:1
	O-C-P	21.179	39.562	18.38	86.8	12.044	1.53	12	4,999:1
B	O-W-P	27.942	42.808	14.87	53.2	10.930	1.36	12	2,266:1
	O-G-P	27.942	46.812	18.87	67.5	10.792	1.75	12	>10,000:1
	O-C-P	27.942	51.108	23.17	82.9	10.304	2.25	12	>10,000:1
C	O-W-P	33.754	55.854	22.10	65.5	17.678	1.25	12	1,110:1
	O-G-P	33.754	53.567	19.81	58.7	18.887	1.05	12	369:1
	O-C-P	33.754	58.996	25.24	74.8	20.746	1.22	12	989:1

TABLE 16. COMPARISONS OF YIELD OF POTATOES GROWN IN AN O-W-P COMBINATION, WITH YIELDS OF POTATOES GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which potatoes in O-W-P are compared	Yield of potatoes in O-W-P (pounds)	Yield of potatoes in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
A	P-P-P	33.537	21.179	−12.36	−36.9	16 011	0 77	12	73:1
	O-G-P	33.537	36 958	3.42	10.2	11 475	0 30	12	5:1
	O-C-P	33 537	39 562	6 02	18 0	11 576	0.52	12	17:1
B	P-P-P	42.808	27 942	−14 87	−34.7	10 930	1.36	12	2,266:1
	O-G-P	42.808	46 812	4 00	9.3	5.970	0.67	12	40:1
	O-C-P	42.808	51 108	8.30	19.4	10.197	0.81	12	93:1
C	P-P-P	55 854	33 254	−22 10	−39.6	17.678	1.25	12	1,110 1
	O-G-P	55 854	53 567	− 2 29	− 4 1	8 504	0.27	12	4 1
	O-C-P	55 854	58 996	3.14	5 6	8.823	0.36	12	7:1

TABLE 17. COMPARISONS OF YIELD OF POTATOES GROWN IN AN O-G-P COMBINATION, WITH YIELDS OF POTATOES GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which potatoes in O-G-P are compared	Yield of potatoes in O-G-P (pounds)	Yield of potatoes in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
A	P-P-P... . ..	36.958	21.179	−15 78	−42 7	11 150	1 42	12	3,332 1
	O-W-P. . ..	36 958	33 537	− 3 42	− 9.3	11 475	0.30	12	5 1
	O-C-P...	36 958	39 562	2 60	7.0	11 727	0.22	12	3:1
B	P-P-P..........	46 812	27 942	−18 87	−40 3	10 792	1.75	12	>10,000 1
	O-W-P..	46.812	42.808	− 4 00	− 8 5	5 970	0 67	12	40 1
	O-C-P........	46.812	51 108	4 30	9 2	7.302	0.59	12	25·1
C	P-P-P..... ...	53 567	33 754	−22 10	−41 3	17.678	1.25	12	1,110.1
	O-W-P........	53.567	55 854	2 29	4.3	8 504	0 27	12	4 1
	O-C-P	53 567	58 996	5 43	10.1	11 565	0.47	12	12 1

TABLE 18. COMPARISONS OF YIELD OF POTATOES GROWN IN AN O-C-P COMBINATION WITH THE YIELDS OF POTATOES GROWN IN OTHER CROPPING SYSTEMS

Section of plot	Combinations with which potatoes in O-C-P are compared	Yield of potatoes in O-C-P (pounds)	Yield of potatoes in combinations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
A	P-P-P..........	39.562	21.179	−18 38	−46.5	12.044	1.53	12	4,999:1
	O-W-P.........	39.562	33.537	− 6 02	−15.2	11.576	0.52	12	17:1
	O-G-P.........	39.562	36.958	− 2 60	− 6 6	11.727	0.22	12	3:1
B	P-P-P.	51.108	27.942	−23.17	−45.3	10.304	2.25	12	>10,000:1
	O-W-P.........	51.108	42.808	− 8 30	−16 2	10.197	0.81	12	93:1
	O-G-P........	51.108	46.812	− 4.30	− 8.4	7.302	0.59	12	25:1
C	P-P-P...... ...	58.996	33.754	−25 24	−42.8	20.746	1.22	12	989:1
	O-W-P.........	58.108	55.854	− 3.14	− 5.3	8.823	0.36	12	7:1
	O-G-P.........	58.108	53.567	− 5.43	− 9.2	11.565	0.47	12	12:1

TABLE 19. COMPARISONS OF YIELD OF TIMOTHY GROWN CONTINUOUSLY, WITH YIELDS OF TIMOTHY GROWN FOR ONE YEAR IN THREE-YEARS ROTATIONS

Section of plot	Rotations with which continuous timothy is compared	Yield of continuous timothy (pounds)	Yield of timothy in rotations of column 2 (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
A	O-W-G........	16.209	11.477	−4.73	−29.2	4.779	0.99	14	582 : 1
	O-G-P.........	16.209	10.769	−5.44	−33.6	4.347	1.25	14	3,332 : 1
B	O-W-G.........	21.381	15.705	−5.68	−26.6	3.146	1.81	14	>10,000 : 1
	O-G-P.........	21.381	15.938	−5.44	−25.4	6.229	0.87	14	249 : 1
C	O-W-G.........	25.096	18.477	−6.62	−26.4	4.315	1.53	14	>10,000 : 1
	O-G-P.........	25.096	18.492	−6.60	−26.3	5.938	1.11	14	1,332 : 1

The yield of timothy grown continuously and the yields of timothy grown for one year in three-years rotations are compared in table 19. This table presents a very striking exception to the general rule, that crops grown in continuous culture produce less than those grown in rotations. The data presented here show a distinct and uniformly greater yield for continuous timothy than for timothy in rotations. In each instance the odds are high and the difference is greater than 25 per cent. Some of the reasons which account in part for this condition are: (1) a very excellent and clean stand of timothy on the continuous-timothy plots; (2) a good grass soil; (3) a comparatively short period of years for results from rotations and the upper limit for continuous culture, giving whatever advantage there may be to the continuous-culture plots; and (4) one-year timothy not giving the maximum yield, as timothy hardly becomes established in one year. The second-year meadow which is seeded to grass alone is usually better than the first year. If clover had been included with the grass seed in the rotation, the results would have been changed, as clover reaches its maximum production the first year after seeding. The detailed data show that the advantage of continuous timothy over timothy in rotation decreased with the prolongation of the period. Likewise, the hay on the continuous-culture plots was getting poorer and poorer in quality, because of the increased amount of weeds. In order to get a fair comparison between continuous timothy and timothy in rotations, the crop should be left down for two years in the rotations and the experiment should be continued for a longer period of time. These results are in no way to be interpreted as showing an advantage for continuous timothy over timothy in rotations if the rotations include two or three years of grass.

The yield of timothy grown in an O-G-P rotation and the yield of timothy grown in an O-W-G rotation are compared in table 20. The actual percentage of gains or losses and the odds are small for each section. One rotation has no advantage over the other, therefore, as far as timothy alone is concerned.

TABLE 20. COMPARISON OF YIELDS OF TIMOTHY GROWN IN O-G-P ROTATION, WITH YIELDS OF TIMOTHY GROWN IN O-W-G ROTATION

Section of plot	Yield of timothy in O-W-G (pounds)	Yield of timothy in O-G-P (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
A.....	11.477	10.769	−0.71	−6 2	3.454	0.21	14	3:1
B.....	15.705	15.938	0.23	1.5	5.738	0.04	14	<1:1
C.....	18.477	18.492	0.01	0.1	5.488	....	14	<1:1

The yield of clover grown in an O-W-C rotation and the yield of clover grown in an O-C-P rotation are compared in table 21. Comparatively small differences occur between the yields of clover in these two rotations, as shown by the actual percentage differences of 17.5 per cent in section

A, 0.5 per cent in section B, and 5.9 per cent in section C. The odds are all low and insignificant. The only indicative fact in the table is a positive difference in favor of O-W-C in each section, which suggests that wheat is a better nurse crop than oats for clover. It is impossible, however, from these figures to say definitely that one rotation is better than the other, so far as the production of clover is concerned.

TABLE 21. COMPARISON OF YIELDS OF CLOVER GROWN IN O-W-C ROTATION, WITH YIELDS OF CLOVER GROWN IN O-C-P ROTATION

Section of plot	Yield of clover in O-W-C (pounds)	Yield of clover in O-C-P (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
A......	16.391	13.523	−2.87	−17.5	4.730	0.61	13	4:1
B......	18.654	18.565	−0.09	− 0.5	6.964	0.01	13	<1:1
C......	21.281	20.017	−1.26	− 5.9	5.168	0.24	14	4:1

COMPARISON OF ONE ROTATION WITH ANOTHER

In the foregoing tables individual crops grown in different cropping systems are compared, and little effort is made to differentiate between rotations as a whole. In choosing between two given rotations, other factors, such as the use to be made of the crops when produced, the kind of land cropped, the amount of labor available, and the market, must be considered, besides the total yield of crops.

In this study, however, only the yield is considered, as all other factors are probably more variable and become more or less individual problems.

Even comparing the yield from one cropping system with that from another is not easy, and the results obtained are not always satisfactory. It is not the purpose here to make such comparisons, but to give one method which may be used in making any desired comparison. The example used is a comparison between the effect of clover and the effect of grass on the other crops in the rotation.

Timothy as compared with clover in rotations

Widely different results have been obtained in comparisons of clover and timothy in similar rotations, and the data published have not proved very conclusively the advantage of clover over timothy in maintaining fertility. The advantages claimed for clover in a rotation have been its undisputed powers of acquiring nitrogen from the air under favorable conditions, its large root growth, its high feeding value, and its large production of organic matter which is added to the soil when the clover sod is turned under. Jordan and Churchill (1919) report the work of seventeen years on crop rotations for comparing the respective powers of clover and timothy in maintaining fertility. With reference to comparison of check plots that received no fertilizer, they state: " The outstanding fact in this connection is that on the timothy plats the crop production

TABLE 22. EFFECT OF SUBSTITUTING CLOVER FOR TIMOTHY IN TWO ROTATIONS*

Crop	Section of plot	Yield of O-W-C (pounds)	Yield of O-W-G (pounds)	Gain of clover over grass (pounds)	Gain of clover over grass (per cent)	Odds	Yield of O-C-P (pounds)	Yield of O-G-P (pounds)	Gain of clover over grass (pounds)	Gain of clover over grass (per cent)	Odds
Oats. Grain	A	4.175	3.112	1 06	34.1	36:1	4 395	4.076	0.32	7 9	6:1
	B	4 764	4.078	0 69	16 9	20:1	5 776	5 033	0.74	14 7	73:1
	C	5 585	4 516	1.07	23.7	158:1	6.230	5.499	0.73	13.3	27:1
Straw	A	9.157	7.177	1.98	27.6	9:1	8.050	7.402	0.65	8 8	5:1
	B	10.614	8.540	2.07	24.2	83:1	11.475	9.154	2.32	25.3	354:1
	C	13 665	9.379	4.29	45 7	2,799:1	12.217	10.771	1.45	13 5	22:1
Wheat: Grain	A	3.801	3 402	0.40	11 8	4:1					
	B	5.215	4.321	0.89	20 6	463:1					
	C	6 259	4.995	1 27	25 5	638:1					
Straw	A	9 296	7.753	1.54	19 9	14:1					
	B	11 038	8 626	2 41	27 9	358:1					
	C	13 431	10 758	2 67	24 8	22 1					
Potatoes	A						39 562	36.958	2 60	7 0	3.1
	B						51 108	46 812	4 30	9 2	25:1
	C						58 996	53 567	5 43	10.1	12.1
Clover	A	16.391					13.523				
	B	18 654					18 565				
	C	21 281					20 017				
Grass	A		11.477					10.769			
	B		15 708					15.938			
	C		18.477					18 492			

* This method might be employed in comparing any pair of rotations which differ only in one crop.

was maintained as efficiently as on the clover plats." . They state further, however, that the soil on the station farm has large potential fertility and that there was no decrease in productivity observed during the last twelve years of cropping even without fertilizer.

It is interesting to study the results obtained in this experiment on the same question. The effect of substituting clover for timothy in two three-years rotations, O-W-G and O-G-P, is shown in table 22. These data are taken from tables 6, 7, 13, 17, 20, and 21. A study of these data shows: (1) whether the crop is oats, wheat, or potatoes, the average difference in all rotations is positive in favor of clover over grass; (2) clover on the average has outyielded grass under the various conditions; (3) the positive gain on potatoes is small and the odds denote a lack of significance; (4) the gains on the yields of grain on the unfertilized section A are significant for only one plot out of three and for five plots out of six when fertilizer or fertilizer plus manure are added (if the wheat and oats are combined in the O-W-G rotation, the odds are 72:1 that there is a significant gain in grain production by using clover instead of timothy); (5) the straw yields show no significant differences among the untreated sections in either rotation (if oats and wheat are combined, the odds are 40:1), but in four out of six of the treated areas the odds are high in favor of clover, and they approach significance in the other two.

This contrast to the statements given above may be explained on the basis of the difference in potential fertility of the soils used in the two experiments. If the experiment reported here had been conducted for a longer period of time, the final results might have been slightly different. These data, however, indicate very strongly, if they do not definitely prove, that clover does have a beneficial effect on the grain crops which follow in the rotation on land similar to that used in this experiment.

EFFECT OF FERTILIZER, AND OF FERTILIZER PLUS MANURE ON THE YIELDS OF VARIOUS CROPS IN THE DIFFERENT CROPPING SYSTEMS

The second problem of this study is the effect of an application of complete fertilizer and of fertilizer plus manure on the yields of various crops in the different cropping systems. In order to study this, all the data for the several years are summarized in tables 23 to 27. As in the study of the effects of the cropping systems on yields, one crop is discussed at a time as it occurs in the various cropping systems. In this way it is possible to assemble all the data on one crop in a single table. The same method of calculation was used in making these tables as was used in the preceding tables. The calculations necessary for each comparison in the five summary tables are illustrated by table 33 in the appendix.

It will be recalled from the plan of the experiment already given that each plot was divided into sections A, B, and C: no treatment being applied to A, fertilizer being added to B, and fertilizer plus manure to C. All comparisons were thus made between these rather short plots placed end to end.

The effects of applications of complete fertilizer and of complete fertilizer and manure on oats grown in the several cropping systems are compared in table 23. The column of odds shows significant gains in practically all comparisons, of fertilizer and of fertilizer plus manure over

TABLE 23. EFFECTS OF FERTILIZER, AND OF FERTILIZER PLUS MANURE, ON OATS IN VARIOUS CROPPING SYSTEMS

Cropping system	Yield per plot (pounds)		Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain				
	No treatment	Fertilizer						
O-O-O....	3.216	3.695	0.48	14.9	0.579	0.83	16	332:1
O-W-O ...	3.581	4.259	0.68	19.0	0.655	1.04	16	1,885:1
O-W-P. .	4.000	4.572	0.57	14.2	0.649	0.88	16	500:1
O-W-G. .	3.169	4.089	0.92	29.0	0.911	1.01	15	976:1
O-G-P..	4.047	4.872	0.82	20.3	0.844	0.97	16	1,070:1
O-W-C....	4.038	4.622	0.58	14.4	1.216	0.48	16	23:1
O-C-P...	4.276	5.515	1.24	29.0	0.945	1.31	16	>10,000:1
	No treatment	Fertilizer plus manure						
O-O-O. .	3.216	4.297	1.08	33.6	1.341	0.81	16	295:1
O-W-O. ..	3.581	5.322	1.74	48.6	1.498	1.16	16	3,665:1
O-W-P. .	4.000	5.689	1.69	42.2	1.454	1.16	16	3,665:1
O-W-G .	3.169	4.435	1.27	40.1	0.934	1.36	15	>10,000:1
O-G-P..	4.047	5.339	1.29	31.9	1.150	1.12	16	3,332:1
O-W-C. ..	4.038	5.481	1.44	35.7	1.460	0.99	16	1,309:1
O-C-P...	4.276	5.991	1.71	40.0	1.351	1.27	16	6,999:1
	Fertilizer	Fertilizer plus manure						
O-O-O...	3.695	4.297	0.60	16.2	1.520	0.39	16	12:1
O-W-O.	4.259	5.322	1.06	24.9	1.395	0.76	16	192:1
O-W-P	4.572	5.689	1.12	24.5	1.232	0.91	16	636:1
O-W-G..	4.006	4.432	0.43	10.7	0.793	0.54	16	35:1
O-G-P... .	4.872	5.339	0.47	9.6	0.890	0.53	16	33:1
O-W-C....	4.622	5.481	0.86	18.6	0.845	1.02	16	1,656:1
O-C-P.....	5.515	5.991	0.48	8.7	0.893	0.54	16	35:1
				Straw				
	No treatment	Fertilizer						
O-O-O.. ..	7.029	8.198	1.17	16.6	1.604	0.73	14	93:1
O-W-O.. .	7.556	9.617	2.06	27.3	1.861	1.11	14	1,332:1
O-W-P ..	8.274	9.456	1.18	14.3	1.531	0.77	14	126:1
O-W-G. .	7.558	8.977	1.42	18.8	1.456	0.98	13	378:1
O-G-P.. ..	7.787	9.298	1.51	19.4	1.767	0.85	14	207:1
O-W-C .	8.935	10.719	1.78	19.9	2.677	0.66	14	57:1
O-C-P ..	8.289	11.528	3.24	39.1	1.458	2.22	14	>10,000:1
	No treatment	Fertilizer plus manure						
O-O-O....	7.029	10.936	3.91	55.6	2.223	1.76	14	>10,000:1
O-W-O. .	7.556	12.105	4.55	60.2	2.498	1.82	14	>10,000:1
O-W-P .	8.274	11.854	3.58	43.3	3.476	1.03	14	749:1
O-W-G..	7.558	9.745	2.19	29.0	1.820	1.20	13	1,428:1
O-G-P .	7.787	10.777	2.99	38.4	2.415	1.24	14	3,165:1
O-W-C. .	8.935	13.561	4.63	51.8	2.455	1.89	14	>10,000:1
O-C-P.. ..	8.289	12.199	3.91	47.2	2.133	1.83	14	>10,000:1
	Fertilizer	Fertilizer plus manure						
O-O-O.....	8.198	10.936	2.74	33.4	1.647	1.66	14	>10,000:1
O-W-O	9.617	12.105	2.49	25.9	2.539	0.98	14	541:1
O-W-P ...	9.456	11.854	2.40	25.4	3.362	0.71	14	83:1
O-W-G	8.739	9.642	0.90	10.3	1.722	0.52	14	23:1
O-G-P	9.298	10.777	1.48	15.9	2.029	0.73	14	93:1
O-W-C	10.719	13.561	2.84	26.5	1.338	2.12	14	>10,000:1
O-C-P	11.528	12.199	0.67	5.8	1.705	0.39	14	10:1

the no-treatment plot, and of fertilizer plus manure over fertilizer; consequently, the column of greatest interest in the table is the one giving the percentage of gains.

The gains in grain yields due to fertilizer treatment alone vary from 14.2 per cent to 29.0 per cent, while the gain recorded for fertilizer and manure are from 31.9 per cent to 48.6 per cent. The gains in yields from plots treated with manure and fertilizer over the gains from plots treated with fertilizer alone are from 8.7 per cent to 24.9 per cent. The gains expressed in percentages are rather strikingly uniform in the various cropping systems; so much so, in fact, that it cannot be concluded from these data that fertilizer or manure will give a greater actual or a greater percentage gain in one cropping system than it will in another. The percentages do indicate, however, that manure will cause a greater increase in the poorer cropping systems than will fertilizer. In the more productive rotations, the fertilizer may cause a greater increase.

The gains in the oats straw are just as significant as the gains in grain; on the average they are a little greater, as shown by the percentages. No conclusions, however, can be drawn as to the different effects of fertilizer or manure on oats in different rotations.

A comparison of the effects of applications of complete fertilizer and of complete fertilizer plus manure on wheat production in several different cropping systems is given in table 24. As in the preceding table, highly significant odds are found in favor of applications of fertilizer, alone or in combination with manure, over the no-fertilizer treatment. The only exception is the straw yield in the O-W-G rotation. Even though the average actual recorded gain is 11.2 per cent, the data are insignificant on account of the high standard deviation. The only insignificant gains in yields from sections treated with fertilizer and manure over those from sections treated with fertilizer alone occur in the same rotation. In neither grain nor straw yields have the gains been sufficiently consistent in this rotation to make reliable the actual gains of 15.5 and 24.7 per cent. The latter gain is probably the best illustration in this paper to show how misleading high average differences may be when the deviations are not considered.

The apparent different effects of fertilizer plus manure on the grain and on the straw are also shown in table 24. If the gains in grain yields due to treatments of fertilizer alone, and the gains in grain yield due to fertilizer plus manure over fertilizer alone, are compared in the various cropping systems, the percentage of gains is greater in every rotation when the fertilizer alone is used, although the actual gains are very nearly the same. On the other hand, if the same comparison is made with straw, the exact reverse occurs, although the actual differences here are much greater because of the manure.

If tables 23 and 24 are compared, the average percentage of gains in the grain production of wheat by the use of fertilizer or of fertilizer plus manure is somewhat greater than in the production of oats, while the effect of these treatments on straw production is approximately the same on both crops.

A comparison of the effects of complete fertilizer and of complete fertilizer plus manure on the production of potatoes grown continuously

TABLE 24. EFFECTS OF FERTILIZER, AND OF FERTILIZER PLUS MANURE, ON GRAIN AND STRAW YIELDS OF WHEAT IN VARIOUS CROPPING SYSTEMS

Cropping system	Yield per plot (pounds)		Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain				
	No treatment	Fertilizer						
W-W-W	3.179	3.883	0.70	22.0	0.668	1.05	12	369:1
O-W-O	3.162	4.454	1.29	40.8	1.032	1.25	12	1,110:1
O-W-P	3.346	4.586	1.24	37.1	1.192	1.04	11	233:1
O-W-G	3.402	4.321	0.92	27.0	0.768	1.20	12	908:1
O-W-C	3.801	5.215	1.41	37.1	0.777	1.81	12	>10,000:1
	No treatment	Fertilizer plus manure						
W-W-W	3.179	4.652	1.47	46.2	1.279	1.15	12	666:1
O-W-O	3.162	5.615	2.45	77.5	1.229	1.99	12	>10,000:1
O-W-P	3.346	6.064	2.72	81.3	1.680	1.62	11	3,332:1
O-W-G	3.402	4.990	1.59	46.7	1.340	1.19	12	860:1
O-W-C	3.801	6.259	2.46	64.7	1.281	1.92	12	>10,000:1
	Fertilizer	Fertilizer plus manure						
W-W-W	3.883	4.652	0.77	19.8	0.969	0.79	12	83:1
O-W-O	4.454	5.615	1.16	26.0	1.393	0.83	12	104:1
O-W-P	4.496	6.000	1.50	33.4	0.694	2.16	12	>10,000:1
O-W-G	4.321	4.990	0.67	15.5	1.428	0.47	12	13:1
O-W-C	5.215	6.259	1.04	19.9	1.086	0.96	12	224:1
				Straw				
	No treatment	Fertilizer						
W-W-W	8.065	9.535	1.47	18.2	1.160	1.27	10	472:1
O-W-O	8.750	10.640	1.89	21.6	1.469	1.29	10	527:1
O-W-P	8.401	9.700	1.30	15.5	1.595	0.82	9	40:1
O-W-G	7.753	8.626	0.87	11.2	1.797	0.48	10	10:1
O-W-C	9.296	11.038	1.74	18.7	1.117	1.56	10	1,733:1
	No treatment	Fertilizer plus manure						
W-W-W	8.065	12.203	4.14	51.3	1.948	2.13	10	>10,000:1
O-W-O	8.750	13.193	4.44	50.7	3.367	1.32	10	599:1
O-W-P	8.401	13.550	5.15	61.3	3.251	1.58	9	932:1
O-W-G	7.753	10.758	3.00	38.7	3.680	0.82	10	54:1
O-W-C	9.296	13.431	4.13	44.4	2.654	1.56	10	1,733:1
	Fertilizer	Fertilizer plus manure						
W-W-W	9.535	12.203	2.67	28.0	1.092	2.45	10	>10,000:1
O-W-O	10.640	13.193	2.55	24.0	3.186	0.80	10	49:1
O-W-P	9.670	13.165	3.49	36.1	2.207	1.58	10	1,866:1
O-W-G	8.626	10.758	2.13	24.7	3.446	0.62	10	20:1
O-W-C	11.038	13.431	2.39	21.7	2.827	0.85	10	61:1

and grown in three different three-years rotations is given in table 25. Positive gains in the yield of potatoes are shown for fertilizer and for fertilizer plus manure in each comparison, the gains in every instance except two being highly significant; yet even there a significant difference probably exists.

The gains are very close to 30 per cent when fertilizer is used regardless of the cropping system, while there is a large variation ranging from 14.4

per cent to 30.5 per cent in the gain due to the addition of manure to the fertilizer. The smallest increases occur where grass or clover is included in the rotation. Either of these crops supplies, at least in part, the organic matter necessary for potato production.

Fertilizer on potatoes, as on wheat, seems to give a greater increase than does manure, although the difference is not very great.

TABLE 25. EFFECTS OF FERTILIZER AND OF FERTILIZER PLUS MANURE, ON YIELDS OF POTATOES IN VARIOUS CROPPING SYSTEMS

Cropping system	Yield per plot (pounds)		Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
	No treatment	Fertilizer						
P-P-P.....	21.179	27.942	6.76	31.9	5.828	1.16	12	714:1
O-W-P....	33.537	42.808	9.27	27.6	7.957	1.17	12	763:1
O-G-P ..	36.958	46.812	9.85	26.7	10.953	0.90	12	160:1
O-C-P. ...	39.562	51.108	11.55	29.2	5.767	2.00	12	>10,000:1
	No treatment	Fertilizer plus manure						
P-P-P ..	21.179	33.754	12.57	59.4	8.138	1.54	12	4,999:1
O-W-P .	33.537	55.854	22.32	66.6	11.649	1.92	12	>10,000:1
O-G-P....	36.958	53.567	16.61	44.9	13.861	1.20	12	908:1
O-C-P.. .	39.562	58.996	19.43	49.1	15.209	1.28	12	1,444:1
	Fertilizer	Fertilizer plus manure						
P-P-P....	27.942	33.754	5.81	20.8	9.722	0.60	12	27:1
O-W-P ..	42.808	55.854	13.05	30.5	6.351	2.05	12	>10,000:1
O-G-P..	46.812	53.567	6.75	14.4	6.435	1.05	12	369:1
O-C-P	51.108	58.996	7.89	15.4	12.993	0.61	12	28:1

The effects of complete fertilizer and of complete fertilizer plus manure on the production of timothy grown continuously and grown in two three-years rotations are compared in table 26. The gains in the yield of timothy treated with fertilizer and with fertilizer plus manure are positive and highly significant in every comparison. Thus the columns in the table giving the actual and percentage gains are the most important. Yields of crops treated with fertilizer alone show an increase of from 31.9 per cent to 48.0 per cent, or an actual difference in acre yield of from 1117 to 1365 pounds, under various cropping systems. The quality of the hay was little if any improved in the two rotations by the addition of fertilizer, but under continuous culture the quality was better when fertilizer was added.

The application of manure to plots already fertilized gave an additional increase of from 16.0 per cent to 17.6 per cent, a very uniform percentage of increase. This approximates one-half the increase due to the use of fertilizer alone. It does not prove, however, that fertilizer alone will give twice the increase that manure alone will give. This comparison is impossible to make, not only in this table but in all the tables from 23 to 27. The results do indicate, however, that greater increases can be expected on the timothy crop when complete fertilizer is used than when manure is used. The ultimate total increase in timothy and the succeeding crops cannot be estimated from data of this kind.

TABLE 26. EFFECTS OF FERTILIZER, AND OF FERTILIZER PLUS MANURE, ON YIELDS OF TIMOTHY IN VARIOUS CROPPING SYSTEMS

Cropping system	Yield per plot (pounds)		Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
	No treatment	Fertilizer						
G-G-G.....	16.209	21.381	5.17	31.9	2.777	1.86	14	>10,000:1
O-W-G .	11.477	15.705	4.23	36.9	3.601	1.17	14	1,999:1
O-G-P.	10.769	15.938	5 17	48.0	4.904	1.05	14	832:1
	No treatment	Fertilizer plus manure						
G-G-G.....	16.209	25.096	8 89	54.8	4.707	1.89	14	>10,000:1
O-W-G .	11.477	18.477	7 00	61.0	4.232	1.65	14	>10,000:1
O-G-P.	10.769	18.492	7 72	71.7	4 683	1.65	14	>10,000:1
	Fertilizer	Fertilizer plus manure						
G-G-G....	21.381	25.096	3 71	17.4	4 416	0 84	14	197:1
O-W-G..	15.705	18 477	2 77	17.6	2 822	0 98	14	541.1
O-G-P.	15.938	18 492	2.55	16.0	2 028	1.26	14	3,665:1

The effects of complete fertilizer and of complete fertilizer plus manure on the production of clover in two three-years rotations are compared in table 27. A significant gain is shown for every section treated with fertilizer or fertilizer plus manure over that given no treatment, but the fertilizer plus manure treatment fails to show a significant gain over fertilizer alone in the O-C-P rotation. The gains in clover production due to the application of fertilizer plus manure are distinctly less than the gains in timothy production from similar treatments.

TABLE 27. EFFECTS OF FERTILIZER, AND OF FERTILIZER PLUS MANURE, ON YIELDS OF CLOVER IN VARIOUS CROPPING SYSTEMS

Cropping system	Yield per plot (pounds)		Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
	No treatment	Fertilizer						
O-C-W ...	16.391	18.654	2 26	13 8	3 039	0 74	13	77:1
O-C-P.....	12 936	18.324	5 39	41 7	4.366	1.23	14	2,999:1
	No treatment	Fertilizer plus manure						
O-C-W. ..	16.391	21 333	4 94	30 1	5 353	0 92	13	253:1
O-C-P....	12.936	20.017	7 08	54.7	3.498	2 02	14	>10,000.1
	Fertilizer	Fertilizer plus manure						
O-C-W.. .	18.654	21 333	2.68	14.4	3.564	0.75	13	81:1
O-C-P....	18 324	20.017	1.69	9 2	4.728	0.36	14	8:1

RELATIVE EFFECTIVENESS OF ROTATIONS AS COMPARED WITH FERTILIZER OR WITH FERTILIZER PLUS MANURE IN MAINTAINING THE PRODUCTION OF OATS AND WHEAT

Since the influence of rotation and of fertilization on the yields of the various crops have been discussed separately, a comparison of the two independent factors in maintaining the production of crops can now be made. To do this, the unfertilized part of the plot (section A) in the various rotations has been compared with the fertilized part (section B) of the given crops in continuous culture, and with the fertilized and manured part (section C). Only two crops, oats and wheat, have been compared, (1) because it is apparent without calculation, that potatoes cannot be grown in continuous culture with or without fertilizer or manure, and that potatoes in the untreated part of any of the rotation plots are better than potatoes in continuous culture in parts with the best fertilizer treatment; (2) because clover is not grown in continuous culture; and (3) because timothy in continuous culture in this experiment has had a distinct advantage over timothy in rotations.

The first comparison is between the untreated part of the oats plots in the various rotations, and the fertilized part of the oats plots in continuous culture. In the production of grain, only two significant differences are obtained, one a positive and the other a negative. Although oats in the O-W-P rotation give a smaller percentage of difference than those in the O-C-P rotation, the yield is nevertheless consistent enough to show significance. Thus oats without fertilizer in an O-W-P rotation can be

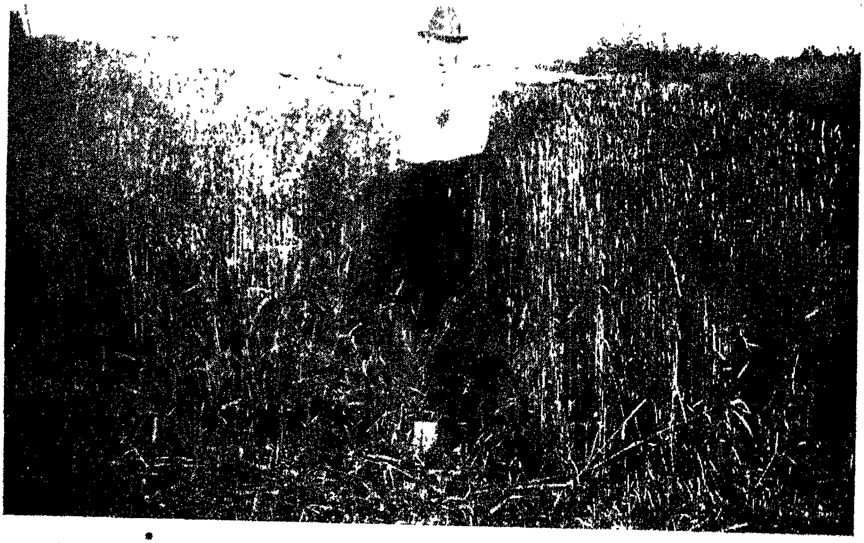

FIGURE 2. GROWTH OF OATS AND WHEAT ON THE CONTINUOUS-CULTURE PLOTS

FIGURE 3. GROWTH OF OATS AND WHEAT ON THE O-W-P ROTATION PLOTS

considered better for grain production than oats grown continuously with fertilizer. On the other hand, oats without fertilizer in an O-W-G rotation give significantly lower yields than do oats grown continuously with fertilizer. The differences in the O-G-P, O-W-C, and O-C-P rota-

TABLE 28. COMPARISON OF YIELDS OF OATS GROWN CONTINUOUSLY WITH FERTILIZER, AND OF OATS GROWN IN ROTATION WITHOUT FERTILIZER

Cropping system	Yield per plot: Continuous oats with fertilizer (pounds)	Yield per plot: Rotation oats without fertilizer (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain				
O-W-O....	3.696	3.619	−0.08	− 2.0	1.03	0.08	14	1:1
O-W-P....	3.696	4.106	0.41	11.0	0.54	0.76	14	145:1
O-W-G....	3.826	3.112	−0.71	−20.0	1.21	0.59	13	31:1
O-G-P.....	3.826	4.136	0.31	9.0	1.84	0.17	13	2:1
O-W-C....	3.696	4.084	0.39	11.0	1.46	0.27	14	5:1
O-C-P....	3.696	4.395	0.70	19.0	1.90	0.37	14	9:1
				Straw				
O-W-O....	7.804	7.342	−0.55	− 7.0	2.39	0.23	12	3:1
O-W-P....	7.804	8.144	0.34	4.0	1.71	0.20	12	3:1
O-W-G....	8.114	7.177	−0.94	−12.0	2.50	0.38	11	7:1
O-G-P.....	8.114	7.544	−0.57	− 7.0	3.14	0.18	11	2:1
O-W-C....	7.804	8.815	1.01	13.0	3.58	0.28	12	4:1
O-C-P.....	7.804	8.050	0.25	3.0	2.29	0.11	12	2:1

FIGURE 4. GROWTH OF OATS AND WHEAT ON THE O-W-C ROTATION PLOTS

The very vigorous growth of straw is to be noted in this picture, in comparison with figures 2 and 3

tions are all positive and in favor of the rotations over the fertilized continuous-culture plots, but the odds are low.

In straw production no significant differences were found in favor of any one system, the odds being low in all of them and the standard deviations noticeably large.

The yields of unfertilized oats in rotations and of continuous oats which received fertilizer plus manure are compared in table 29. Oats receiving fertilizer plus manure, although grown continuously, outyielded unfertilized oats in rotation in every instance, in both grain and straw production. To be sure, the differences in grain production are small in four rotations and the odds are very low and insignificant so far as establishing a difference between the two systems is concerned; but the odds are significant enough to show that good rotations are as effective in maintaining oats yields as are rather heavy annual applications of fertilizer plus manure.

In the production of straw, however, the annual application of fertilizer plus manure was much more effective than were the rotations alone. The straw production in only one rotation, O-W-C, approaches the production under fertilizer treatment. In this rotation oats follows clover, and the actual difference is 18 per cent in favor of the fertilized continuous-culture system, while the odds of 24:1 closely approach significance. When this table is compared with the preceding one, it indicates clearly that manure influenced straw production much more than it did grain production, particularly where the essential elements were supplied.

TABLE 29. COMPARISON OF YIELDS OF OATS GROWN CONTINUOUSLY WITH FERTILIZER PLUS MANURE, AND OF OATS GROWN IN ROTATION WITHOUT FERTILIZER

Cropping system	Yield per plot		Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
	Continuous oats with fertilizer plus manure (pounds)	Rotation oats without fertilizer (pounds)						
Grain								
O-W-O . .	4.478	3.619	−0.86	−19.0	1.60	0.54	14	25:1
O-W-P . .	4.478	4.106	−0.37	− 8.0	1.71	0.22	14	4:1
O-W-G	4.422	3.112	−1.31	−30.0	1.45	0.90	13	226:1
O-G-P . . .	4.422	4.136	−0.28	− 6.0	1.96	0.14	13	2:1
O-W-C .	4.478	4.084	−0.39	− 9.0	2.23	0.17	14	3:1
O-C-P . .	4.478	4.395	−0.08	− 2.0	2.34	0.03	14	<1:1
Straw								
O-W-O	10.769	7.342	−3.43	−32.0	3.00	1.14	12	638:1
O-W-P . .	10.769	8.144	−2.63	−24.0	2.92	0.90	12	160:1
O-W-G	10.771	7.177	−3.59	−33.0	2.45	1.47	11	2,199:1
O-G-P .	10.771	7.544	−3.23	−30.0	2.73	1.18	11	499:1
O-W-C . . .	10.769	8.815	−1.95	−18.0	3.34	0.58	12	24:1
O-C-P .	10.769	8.050	−2.72	−25.0	2.73	1.00	12	293:1

The yields of unfertilized wheat in rotations and of wheat grown continuously with an application of complete fertilizer are compared in table 30. Both the grain and the straw yields in the fertilized non-rotated plots are greater than in the rotated non-fertilized plots. These differences are small but consistent. The O-W-C rotation approaches very closely the fertilized continuous-culture plots in the actual yield of both grain and straw. The absence of a significant difference in each comparison indicates that wheat yields can be maintained as well by fertilization for at least eight years as by a good rotation of crops.

TABLE 30. COMPARISON OF YIELDS OF WHEAT GROWN CONTINUOUSLY WITH FERTILIZER, AND OF WHEAT GROWN IN ROTATION WITHOUT FERTILIZER

Cropping system	Yield per plot		Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
	Continuous wheat with fertilizer (pounds)	Rotation wheat without fertilizer (pounds)						
Grain								
O-W-O	3.883	3.162	−0.72	−19.0	1.57	0.46	12	12:1
O-W-P	3.745	3.346	−0.40	−11.0	1.77	0.23	11	3:1
O-W-G . . .	3.883	3.402	−0.48	−12.0	1.59	0.30	12	5:1
O-W-C	3.883	3.801	−0.08	− 2.0	1.73	0.05	12	1:1
Straw								
O-W-O	9.535	8.750	−0.79	− 8.0	2.58	0.31	10	4:1
O-W-P	9.583	8.401	−1.18	−12.0	2.69	0.44	9	7:1
O-W-G	9.535	7.753	−1.78	−19.0	2.86	0.62	10	20:1
O-W-C	9.535	9.296	−0.24	− 3.0	3.06	0.08	10	1:1

The yields of unfertilized wheat in rotations and of wheat grown continuously on the same land with an application of complete fertilizer plus manure are compared in table 31. Without exception the fertilized and manured sections under continuous culture yielded more wheat grain and straw than did the unfertilized rotated sections. This difference varied from 18 per cent to 32 per cent in the grain, the smaller differences occurring with the better rotations, and from 24 per cent to 36 per cent in the straw without much regard to the kind of a rotation. This table shows rather conclusively that fertilizer combined with manure is more effective in the production of wheat during an eight-years period than the best rotation included in this test.

TABLE 31. COMPARISON OF YIELDS OF WHEAT GROWN CONTINUOUSLY WITH FERTILIZER PLUS MANURE, AND OF WHEAT GROWN IN ROTATION WITHOUT FERTILIZER

Cropping system	Yield per plot: Continuous wheat with fertilizer plus manure (pounds)	Yield per plot: Rotation wheat without fertilizer (pounds)	Difference in yield (pounds)	Gain or loss (per cent)	δ	Z	N	Odds
				Grain				
O-W-O...	4.652	3 162	−1 49	−32 0	2 04	0 73	12	57:1
O-W-P..	4 748	3 346	−1 40	−30 0	2 19	0 64	11	27:1
O-W-G..	4 652	3 402	−1 25	−27 0	1.36	0 92	12	170:1
O-W-C	4 652	3.801	−0.85	−18 0	1 51	0 56	12	21:1
				Straw				
O.W.O ...	12.203	8.750	−3 45	−28.0	2.90	1 19	10	328:1
O-W-P .	12 526	8 401	−4 12	−33 0	2 77	1.49	9	681:1
O-W-G .	12.203	7 753	−4.45	−36.0	2.91	1 53	10	1,571:1
O-W-C. .	12.203	9.296	−2 91	−24 0	3 00	0.97	10	113:1

SUMMARY

These experiments in fertilizer, manure, and various cropping systems were inaugurated in 1914, and the results up to and including those for 1921 are reported in this bulletin. This period is somewhat short for conclusive results on this type of experiment, but the fact that each crop in each rotation appeared each year means a shortened period for results.

No attempt is made to compare the various systems from the economic standpoint, because such calculations are not adaptable to any considerable period of time.

All crops except timothy gave better yields when they were grown in rotation than when they were grown in continuous culture. This exception was probably the result of too short a period in the rotation for timothy. Continuous culture of any crop should not be practiced unless with grass, and this, if used, should be combined with fertilizer and manure and not extended longer than five or six years.

The best rotations used in this experiment included red clover. A legume not only increases the production of crops which follow, but furnishes a valuable feed.

A cultivated crop should probably be included in all rotations used on land suited to cultivation, because of the good seedbed preparation which can follow, the elimination of weeds, and the best use of coarse organic matter.

A three-years rotation is too short under most conditions

Oats should probably never follow grass.

When grass is included in a rotation, it should be accompanied by a legume, and for its best production should remain down longer than one year.

Red clover is without doubt more valuable than timothy in a rotation under the conditions of this experiment.

Fertilizer and manure as employed on these plots never failed to increase production regardless of the crop used to measure the effect. It is probably unwise, however, to make rather heavy applications of fertilizer or manure to all the crops.

Good crop rotations without manure were practically as effective in maintaining the production of oats and wheat as were heavy applications of complete fertilizer on crops grown in continuous culture; while the best rotation without manure was practically as good as a heavy application of fertilizer combined with a medium application of manure on crops grown continuously.

It is hoped that some of the principles that are indicated by the data given herein may aid in the choice of rotations and in the forecasting of results which may be expected from certain cropping systems.

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APPENDIX

For the benefit of persons who wish to know the method of calculation employed in this paper to compute the expressions of differences and significance, tables 32 and 33 are included.

The detailed calculations in table 32 were used to show how the comparison was made between oats grown continuously and oats grown alternately with wheat under the three conditions: (1) no treatment, (2) application of fertilizer, and (3) application of fertilizer plus manure. The upper half of the table is concerned with the grain yields, while the lower half is concerned with the straw. Six such tables as these are necessary for one summary table such as that given on page 8.

The formulas used in calculating the standard deviation and Z appear in footnotes to this table.

In a similar way, the detailed calculations necessary for the comparisons between the different treatments given to a single plot are shown in table 33. The comparisons in this table are made between (1) the unfertilized and the fertilized sections, (2) the unfertilized and the fertilizer-plus-manure sections, and (3) the fertilized and the fertilizer-plus-manure sections. The crop used in the comparisons is oats, and the combination represented is O-W-O-W.

It is hoped that these tables may illustrate the methods used, and may also stimulate interest in this method of handling similar data. Where the facts can be paired to advantage, this method helps to eliminate systematic errors, and, when the odds are large enough, to give added confidence to the results.

TABLE 32. COMPARISONS OF YIELD OF OATS GROWN CONTINUOUSLY, WITH YIELD OF OATS GROWN ALTERNATELY WITH WHEAT, 1915–1921

(This table is given to show in detail the method of calculation)

Series	Year	No treatment					Fertilizer					Fertilizer plus manure				
		Yield of oats per plot		D (pounds)	D^2		Yield of oats per plot		D (pounds)	D^2		Yield of oats per plot		D (pounds)	D^2	
		Continuous (pounds)	Alternating with wheat (pounds)				Continuous (pounds)	Alternating with wheat (pounds)				Continuous (pounds)	Alternating with wheat (pounds)			
							Grain									
I...	1915	4.25	3.19	−1.06	1.1236	...	5.31	5.38	0.07	0.0049	...	6.13	6.25	0.12	0.0144	...
	1916	4.00	4.10	0.10	0.0100	...	4.50	4.90	0.40	0.1600	...	5.80	6.40	0.60	0.3600	...
	1917	2.40	3.30	0.90	0.8100	...	3.70	4.00	0.30	0.0900	...	0.50	4.30	3.80	14.4400	...
	1918	2.55	2.00	−0.55	0.3025	...	2.65	2.85	0.20	0.0400	...	3.45	5.95	2.50	6.2500	...
	1919	1.35	1.05	−0.30	0.0900	...	1.85	1.60	−0.25	0.0625	...	2.10	0.50	−1.60	2.5600	...
	1920	2.40	1.75	−0.65	0.4225	...	2.00	1.70	−0.30	0.0900	...	5.20	6.15	0.95	0.9025	...
	1921	3.45	3.20	−0.25	0.0625	...	3.85	4.40	0.55	0.3025	...	5.20	5.20	...	...	...
II....	1915	4.94	4.63	−0.31	0.0961	...	5.63	5.44	−0.19	0.0361	...	4.88	5.25	0.37	0.1369	...
	1916	3.50	5.10	1.60	2.5600	...	4.10	6.00	1.90	3.6100	...	4.90	7.50	2.60	6.7600	...
	1917	3.70	5.90	2.20	4.8400	...	4.55	5.20	0.65	0.4225	...	4.40	6.40	2.00	4.0000	...
	1918	4.00	5.35	1.35	1.8225	...	3.30	5.70	2.40	5.7600	...	5.75	5.20	−0.55	0.3025	...
	1919	1.40	2.00	0.60	0.3600	...	2.20	3.15	0.95	0.9025	...	2.05	3.10	1.05	1.1025	...
	1920	3.19	4.55	1.40	1.9600	...	3.80	5.15	1.35	1.8225	...	6.45	5.20	−1.25	1.5625	...
	1921	3.30	4.55	1.25	1.5625	...	4.30	5.35	1.05	1.1025	...	5.88	7.25	1.37	1.8769	...
	Total	44.39	50.67	6.28	16.0222	...	51.74	60.82	9.08	14.4060	...	62.69	74.65	11.96	40.2682	...
	Average	3.171	3.619	0.45	1.1444	...	3.696	4.344	0.65	1.0290	...	4.478	5.332	0.85	2.8763	...
	δ*	...	...	...	...	0.971	...	...	...	...	0.779	...	...	...	...	1.468
	Z	...	...	...	...	0.46	...	...	...	...	0.83	...	...	...	...	0.58
	Odds	...	...	...	...	15:1	...	...	...	...	187:1	...	...	...	...	34:1

TABLE 32 (*concluded*)

Series	Year	No treatment: Yield of oats per plot: Continuous (pounds)	No treatment: Yield of oats per plot: Alternating with wheat (pounds)	No treatment: D (pounds)	No treatment: D^2		Fertilizer: Yield of oats per plot: Continuous (pounds)	Fertilizer: Yield of oats per plot: Alternating with wheat (pounds)	Fertilizer: D (pounds)	Fertilizer: D^2		Fertilizer plus manure: Yield of oats per plot: Continuous (pounds)	Fertilizer plus manure: Yield of oats per plot: Alternating with wheat (pounds)	Fertilizer plus manure: D (pounds)	Fertilizer plus manure: D^2	
							Straw									
I	1915	10.50	7.50	−3.00	9.0000		13.00	12.00	1.00	1.0000		15.00	14.75	−0.25	0.0625	
	1916	6.60	6.70	0.10	0.0100		8.40	8.00	0.40	0.1600		10.90	11.50	0.60	0.3600	
	1917	5.70	8.70	3.00	9.0000		10.70	14.30	3.60	12.9600		14.30	14.20	−0.10	0.0100	
	1918	4.05	3.00	−1.05	1.1025		5.45	4.25	−1.20	1.4400		10.35	11.65	1.30	1.6900	
	1920†	4.75	3.15	−1.60	2.5600		4.40	4.25	−0.15	0.0225		10.75	10.35	−0.40	0.1600	
	1921	3.40	3.15	−0.25	0.0625		3.70	4.30	0.60	0.3600		7.10	5.90	−1.20	1.4400	
II	1915	12.25	11.75	−0.50	0.2500		13.50	14.25	0.75	0.5625		12.75	13.75	1.00	1.0000	
	1916	6.80	7.80	1.00	1.0000		6.70	11.30	4.60	21.1600		8.10	13.60	5.50	30.2500	
	1917	10.10	14.10	4.00	16.0000		10.75	17.80	7.05	49.7025		12.90	17.40	4.50	20.2500	
	1918	5.80	8.75	2.95	8.7025		5.80	9.20	3.40	11.5600		10.05	9.00	−1.05	1.1025	
	1920†	5.65	7.65	2.00	4.0000		6.95	9.10	2.15	4.6225		11.15	10.75	−0.40	0.1600	
	1921	3.30	5.85	2.55	6.5025		4.30	7.45	3.15	9.9225		5.88	10.05	4.17	17.3889	
	Total	78.90	88.10	9.20	58.1900		93.65	116.20	22.55	113.4725		129.23	142.90	13.67	73.8739	
	Average	6.575	7.342	0.77	4.8492		7.804	9.683	1.88	9.4560		10.769	11.908	1.14	6.1562	
	δ*					2.063					2.441					2.204
	Z					0.37					0.77					0.52
	Odds					7:1					73:1					17:1

$*\delta = \sqrt{\frac{\sum D^2}{n} - m^2}$. M = average difference. $Z = \frac{M}{\delta}$. Odds read from H. H. Love (1924).

† Data on straw for 1919 not taken.

TABLE 33. EFFECT OF FERTILIZER, AND OF FERTILIZER PLUS MANURE, ON YIELDS OF OATS GROWN ALTERNATELY WITH WHEAT

(This table is given to show in detail the method of calculation)

Series	Year	Yield of oats per plot		D (pounds)	D²		Yield of oats per plot		D (pounds)	D²		Yield of oats per plot		D (pounds)	D²	
		No treatment (pounds)	Fertilizer (pounds of oats)				No treatment (pounds)	Fertilizer plus manure (pounds of oats)				Fertilizer (pounds)	Fertilizer plus manure (pounds of oats)			
							Grain									
I.	1914*	1.75	2.88	1.13	1.2769		1.75	5.50	3.75	14.0625		2.88	5.50	2.62	6.8644	
	1915	3.19	5.38	2.19	4.7961		3.19	6.25	3.06	9.3636		5.38	6.25	0.87	0.7569	
	1916	4.10	4.90	0.80	0.6400		4.10	6.40	2.30	5.2900		4.90	6.40	1.50	2.2500	
	1917	3.30	4.00	0.70	0.4900		3.30	4.30	1.00	1.0000		4.00	4.30	0.30	0.0900	
	1918	2.00	2.85	0.85	0.7225		2.00	5.95	3.95	15.6025		2.85	5.95	3.10	9.6100	
	1919	1.05	1.60	0.55	0.3025		1.05	0.50	−0.55	0.3025		1.60	0.50	−1.10	1.2100	
	1920	1.75	1.70	−0.05	0.0025		1.75	6.15	4.40	19.3600		1.70	6.15	4.45	19.8025	
	1921	3.20	4.40	1.20	1.4400		3.20	5.20	2.00	4.0000		4.40	5.20	0.80	0.6400	
II.	1914	4.88	4.44	−0.44	0.1936		4.88	5.00	0.12	0.0144		4.44	5.00	0.56	0.3136	
	1915	4.63	5.44	0.81	0.6561		4.63	5.25	0.62	0.3844		5.44	5.25	−0.19	0.0361	
	1916	5.10	6.00	0.90	0.8100		5.10	7.50	2.40	5.7600		6.00	7.50	1.50	2.2500	
	1917	5.90	5.20	−0.70	0.4900		5.90	6.40	0.50	0.2500		5.20	6.40	1.20	1.4400	
	1918	5.35	5.70	0.35	0.1225		5.35	5.20	−0.15	0.0225		5.70	5.20	−0.50	0.2500	
	1919	2.00	3.15	1.15	1.3225		2.00	3.10	1.10	1.2100		3.15	3.10	−0.05	0.0025	
	1920	4.55	5.15	0.60	0.3600		4.55	5.20	0.65	0.4225		5.15	5.20	0.05	0.0025	
	1921	4.55	5.35	0.80	0.6400		4.55	7.25	2.70	7.2900		5.35	7.25	1.90	3.6100	
	Total	57.30	68.14	10.84	14.2652		57.30	85.15	27.85	84.3349		68.14	85.15	17.01	49.1285	
	Average	3.581	4.259	0.678	0.8916		3.581	5.322	1.74	5.2700		4.259	5.322	1.06	3.0705	
	δ†					0.655					1.498					1.395
	Z					1.04					1.16					0.76
	Odds					1,885:1					3,665:1					192:1

TABLE 33 (*concluded*)

Series	Year	Yield of oats per plot: No treatment (pounds)	Yield of oats per plot: Fertilizer (pounds) of oats)	D (pounds)	D		Yield of oats per plot: No treatment (pounds)	Yield of oats per plot: Fertilizer plus manure (pounds of oats)	D (pounds)	D²		Yield of oats per plot: Fertilizer (pounds)	Yield of oats per plot: Fertilizer plus manure (pounds) of oats)	D (pounds)	D²	
							Straw									
I....	1914	4.19	7.13	2.94	8 6436		4 19	13.88	9.69	93.8961		7.13	13.88	6.75	45.5625	
	1915	7.50	12.00	4.50	20 2500		7.50	14.75	7.25	52.5625		12.00	14.75	2.75	7.5625	
	1916	6.70	8 00	1.30	1 6900		6.70	11.50	4.80	23.0400		8.00	11.50	3.50	12.2500	
	1917	8.70	14.30	5.60	31 3600		8.70	14.20	5.50	30 2500		14.30	14.20	-0.10	0.0100	
	1918	3.00	4 25	1.25	1.5625		3.00	11.65	8.65	74.8225		4.25	11.65	7 40	54.7600	
	1920‡	3 15	4.25	1.10	1 2100		3.15	10.35	7.20	51.8400		4 25	10.35	6.10	37.2100	
	1921	3.15	4 30	1.15	1.3225		3.15	5.90	2.75	7.5625		4.30	5.90	1.60	2.5600	
II ...	1914	13.50	11.31	-2.19	4.7961		13 50	12 69	-0 81	0.6561		11 31	12.69	1.38	1 9044	
	1915	11.75	14 25	2.50	6.2500		11.75	13.75	2.00	4.0000		14.25	13.75	-0.50	0.2500	
	1916	7.80	11.30	3.50	12.2500		7 80	13 60	5.80	33.6400		11.30	13.60	2.30	5 2900	
	1917	14.10	17.80	3.70	13.6900		14 10	17 40	3 30	10.8900		17.80	17.40	-0.40	0.1600	
	1918	8.75	9.20	0.45	0.2025		8 75	9.00	0.25	0.0625		9.20	9.00	-0.20	0.0400	
	1920‡	7.65	9.10	1.45	2.1025		7.65	10.75	3.10	9.6100		9.10	10.75	1.65	2.7225	
	1921	5.85	7.45	1.60	2.5600		5.85	10.05	4.20	17.6400		7.45	10.05	2.60	6.7600	
	Total	105.79	134.64	28 85	107.8897		105.79	169.47	63.68	377 1686		134.64	169.47	34 83	177.0419	
	Average	7.556	9.617	2.06	7.7064		7.556	12.105	4.55	26.9406		9.617	12.105	2.49	12.6458	
	δ†					1.861					2 498					2.539
	Z					1.11					1.82					0.98
	Odds					1.332:1					>10,000:1					>10,000:1

* 1914 yields are used in calculating differences due to fertilizer and fertilizer plus manure, assuming that the effect of such treatment is immediate as contrasted with the effect of a rotation.

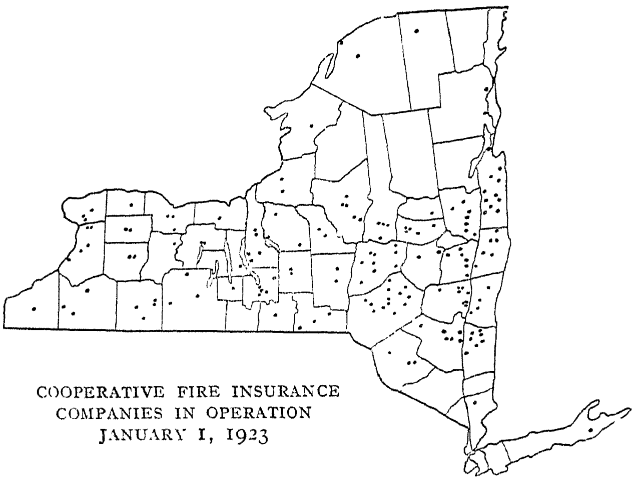
† The same formulae are used in calculating δ and Z as in the preceding table. Odds are also read as in the preceding table

‡ Data on straw for 1919 not taken.

December, 1924 Bulletin 435

The Organization and Development of Cooperative Fire Insurance Companies in New York

R. W. Bartlett



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CONTENTS

THE ORGANIZATION AND DEVELOPMENT OF COOPERATIVE FIRE INSURANCE COMPANIES IN NEW YORK

R. W. Bartlett

PURPOSES OF THIS STUDY

Cooperative agricultural organizations have assumed a position of considerable importance in New York State, but, since they are largely of recent origin, sufficient time has not yet elapsed for the majority of them to prove definitely their stability. On the other hand, cooperative fire insurance companies, thru their long period of operation, and because of their high financial rating, have proved their soundness and stability. This investigation has been made with the purpose of studying the costs, and some of the factors contributing to the success, of the cooperative fire insurance companies in this State.

METHODS

Most of the data were obtained from the New York State Insurance Reports, which have been compiled annually by the State Insurance Department since 1910. Data on fire losses were obtained from the Co-operative Fire Underwriters Association of New York State, at Albany. Details of operation were obtained from officers and managers experienced in the administration of these companies.

HISTORY OF COOPERATIVE FIRE INSURANCE

The first cooperative fire insurance associations were authorized in New York State in 1836, by special acts of the Legislature. Their powers and regulations were prescribed by their charters. These associations were authorized to transact business only in the township in which their principal place of business was located. Their charters were granted for a period of thirty years, but could be extended by the Legislature. The majority of the associations organized in this early period existed for only a short time.

Some of the reasons that induced individuals to organize themselves into associations for mutual protection against fire losses were: excessive insurance costs of stock companies; uncertain protection because of the instability of many of the stock companies then writing farm insurance; and the fact that it was then possible for fire insurance companies to include certain technicalities[1] in their policies that enabled them to evade the payment of honest losses. At that time, many stock companies insuring farm property were unacquainted with this class of property, and had few facts or data which would enable them to establish this

Author's acknowledgment. The investigation was conducted under the direction of Professors W. I. Myers and G. F. Warren. Mr. N. F. Webb, President of the New York State Central Organization of Cooperative Fire Insurance, Mr. G. H. Jamison, Chief of the Cooperative Fire and Licensing Bureau, and Mr. F. P. Tucker, Manager of the Co-operative Fire Underwriters Association, cooperated in furnishing data and explaining details of operation. Data and tabulations were checked by Mr. I. J. Call.

[1] Woodruff, E. H., Cases on insurance, 1924. Preface.

business on a sound basis. As a result of the weaknesses prevalent in the then-existing system of fire insurance, many cooperative associations were formed.

Of the farmer-owned cooperative fire insurance companies now actively operating, the first was organized in Perth, New York, on March 1, 1853.

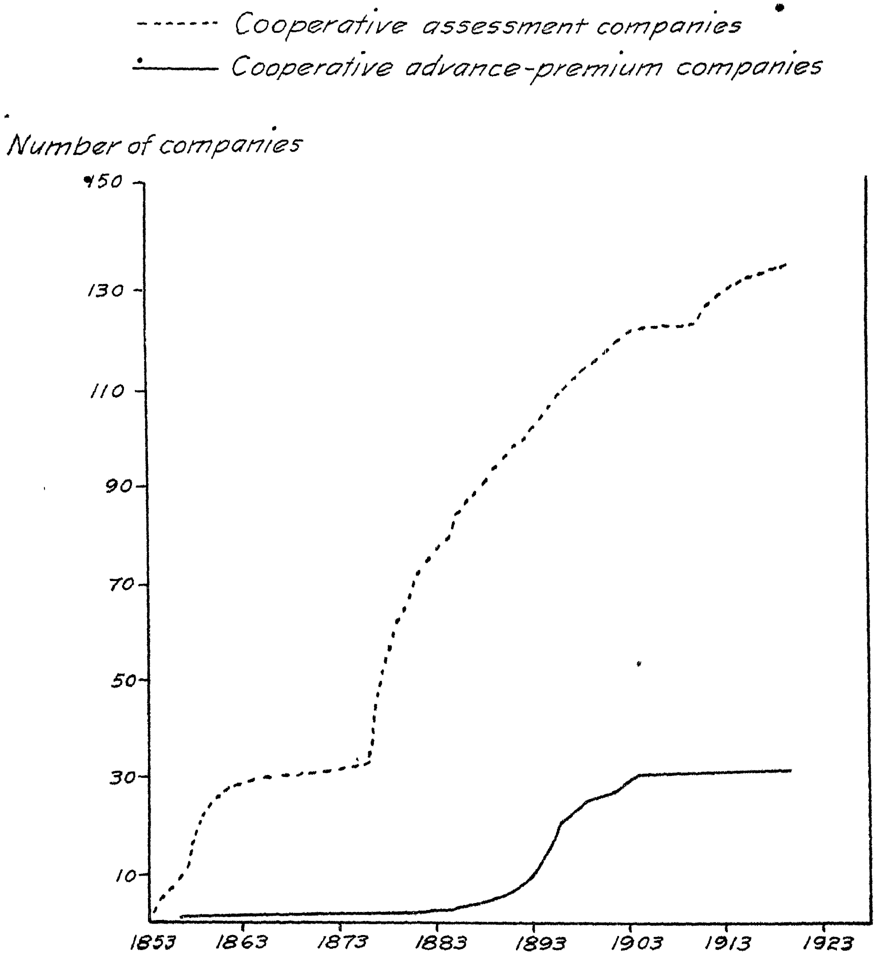

FIGURE 1. GROWTH IN NUMBER OF COOPERATIVE COMPANIES

It is now known as the Fulton and Montgomery Counties Farm Mutual Fire Insurance Company. On January 1, 1923, seventy years from the time of its organization, this company had 3028 policies in force, with a total insurance of $7,913,260.[2] Within ten years from the date of its organization, there were thirty cooperative fire insurance associations actively operating in the State.

[2] See the Sixty-fourth annual report of the Superintendent of Insurance of the State of New York, part 4, 1923.

TABLE 1. COOPERATIVE FIRE INSURANCE COMPANIES IN OPERATION JANUARY 1, 1923

Year organized	Assessment companies	Advance-premium companies
1853–1862	29	1*
1863–1872	2	0
1873–1882	41	1*
1883–1892	26	5
1893–1902	21	21
1903–1912	8	2
1913–1922	8	1
Total	135	31

* Originally organized as assessment companies.

In 1857, the Legislature enacted a general law for the incorporation of town fire insurance associations.[3] This provided that any number of persons, not less than twenty-five, collectively owning property of not less than $50,000 value, could form themselves into an incorporated company. The maximum risk could not exceed $2000, nor the term of the policy be longer than five years. Property that could be insured was limited to detached dwellings and their contents and to farm buildings and their contents. About forty associations were organized under this law, of which thirty are now in active operation. The number of associations organized between 1853 and 1923 can be seen in table 1. Thirteen of the thirty associations organized in the next ten-years period were organized in the two years following the enactment of the cooperative law.

About 1875, the committee on insurance of the New York State Grange took up the question of organizing fire insurance associations in each county for the protection of its members. As a result, eleven grange associations were organized in the three years following. Seventeen other associations were organized during this same period, doubtless due in some degree to the influence of the grange associations. The grange associations were organized without warrant of statutory law, but under what was called the honor plan. Each association had its own articles of association and by-laws, but the same general plan of assessing members for losses was followed in all of them.

In 1879, the Legislature passed an act authorizing the organization of town and county cooperative fire insurance associations.[3] By a previous amendment, parts of the former cooperative law had been repealed. Under this new act, town associations could be formed to do business in one or more towns, and county associations in one county. Companies were authorized to do business after *bona fide* agreements had been entered into covering property to be insured. County associations must have not less than $100,000, and town associations not less than $50,000, insurance. The largest risk that could be written by a town association was $3000, and by a county association, $5000.

[3] New York State Report of Town and County Cooperative Fire Insurance Companies, 1909.

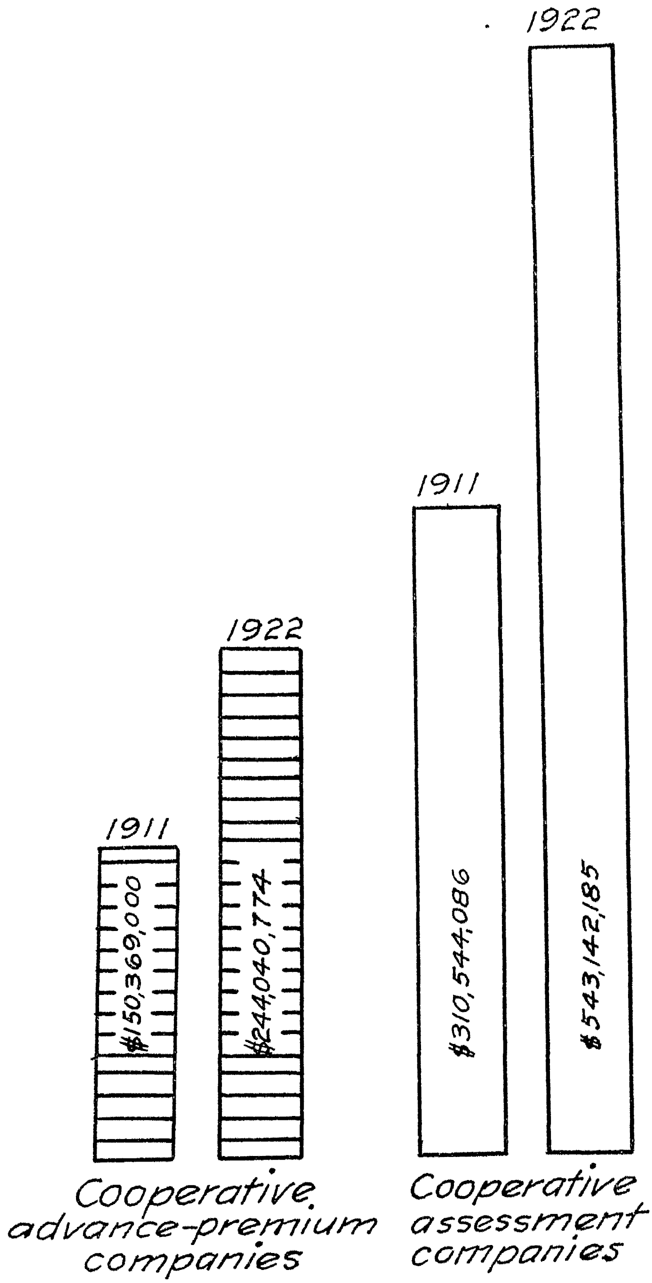

FIGURE 2. TOTAL AMOUNT OF INSURANCE OF COOPERATIVE COMPANIES

In 1883, the New York State Central Organization of Coöperative Fire Insurance was organized. On January 1, 1923, this organization had 98 member companies which, together, had 311,589 policies and $605,451,084 insurance.[4] Its membership includes both assessment and advance-premium fire insurance companies. As stated in its by-laws, the objects of this organization are to foster and to protect the interests, the growth, and the general welfare of cooperative fire insurance companies. By its requirement of standardized annual reports, greater uniformity in matters of insurance and in keeping records has been obtained. Thru combined effort the member companies attempt to obtain just and proper legislation. A convention is held each year, at which problems of common interest are discussed and action taken concerning them. Its forty years of active operation prove that this organization has rendered real service to cooperative companies.

Before 1886 it had been the practice of all associations to do business on the assessment plan, collecting from each policyholder, at the end of each year, his *pro rata* share of the losses and expenses of that year. In that year an association was organized in Catskill, New York, to do business in three counties, an amendment having been passed that increased the territorial limit from one to three counties.[3] An advance premium that was deemed sufficient to pay the entire cost of the insurance for the coming year was charged by this new association. This new form of organization proved successful, and, as a result, a number of other associations were organized under the same plan. Some assessment companies changed to the advance-premium plan. By 1898, twenty-five companies were operating under this plan, of which twenty-four were still active on January 1, 1923.

On April 21, 1898, the advance-premium companies organized to form the Co-operative Fire Underwriters Association of New York State.[3] On January 1, 1923, the 21 member companies of this association, together, had $223,338,385 insurance.[5] The purposes of the association are: cooperation among its members in the transaction of business; exchange of business experience; and compilation of statistics relating to cooperative fire insurance. Property insured by the members of this association is divided into classes, and the premium rate is based on the risk. A secretary and several assistants are employed, who devote their entire time to carrying out the functions for which the association was organized. Since its organization, none of the members of the association have been forced, because of a deficit, to levy an extra assessment on their policyholders.

In 1909, the present New York State Fire Insurance Law was enacted. By the provisions of this law, all cooperative insurance associations were brought under the direct control of the State Superintendent of Insurance. As a result of the regulations imposed by the Department of Insurance after the enactment of this law, cooperative fire insurance in this State ranks second to none in stability and soundness. The greatest benefit derived from the direct control exercised by the insurance department over the cooperative companies was the standardization effected in the many different instruments and practices employed by the companies.

[4] Annual report of New York State Central Organization of Co-operative Fire Insurance, 1922.
[5] Combined statement, December 31, 1922, Associated Co-operative Fire Insurance Companies of New York State.

This standardization affected policies, records, methods of premium payment, limitation of management expenses and of risks, and methods for making good any deficiency. The Chief of the Cooperative Fire and Licensing Bureau has direct charge of those persons examining and checking the records of the cooperative fire insurance companies. The books and records of each insurance company are examined by a representative from this bureau at least once in every five years. This service requires about one-half the time of an examiner. Each company is required to file an annual statement, showing its financial condition as of December 31. These statements, which are on printed forms supplied by the Department, are checked and audited. This work, together with correspondence incidental thereto, requires about one-fourth of the time of a clerk.

Failure of a cooperative company to pay losses is not allowed. In case of a deficiency, an assessment must be made by the directors to make it good. This results in affording to the policyholders of the State something which is unique in the insurance world,—absolute protection.

FIRE LOSSES AND THEIR CAUSES

The annual fire losses of individual cooperative companies during the period 1910–1922 ranged from $.13 to $6.47 per $1000 insurance. The average annual loss of 135 assessment companies[6] was $2.29 per $1000 insurance, and of 31 advance-premium companies, $3.17 per $1000 insurance.[7]

Causes of fires

TABLE 2. AMOUNT AND CAUSES OF 1667 LOSSES ON FARM PROPERTY OCCURRING 1918–1922*

Causes	1918	1919	1920	1921	1922	1918–1922 Total	1918–1922 Per cent of total
Unknown..	$36,033	$14,810	$57,673	$76,194	$119,351	$304,061	37
Lightning..	17,666	43,166	29,020	41,606	4,080	171,538	21
Chimney....	7,146	14,080	6,942	7,836	17,543	53,547	11
Spontaneous combustion..	2,376	11	20	3,651	19,659	25,717	3
Incendiary....	4,710	1,948	4,343	10,432	3,968	25,401	3
Lantern...	663	.....	155	2,569	17,394	20,781	2
Miscellaneous	49,383	98,279	16,882	31,361	34,771	230,676	23
Total.....	$117,977	$172,294	$115,035	$173,649	$244,766	$831,721	100

* Data on losses were obtained from the Co-operative Fire Underwriters Association of New York State, at Albany, New York

Losses by fires from chimneys, furnaces, stoves, and stovepipes, can be reduced by greater preventive effort. Companies with heavy losses from these causes can reduce them by requiring rigid inspections.

Losses from spontaneous combustion averaged only 3 per cent for the five-years period of recorded losses. Of the losses occurring in 1922,

[6] See Appendix E.
[7] See Appendix F.

8 per cent were listed under this heading. Wet weather during the haying season is responsible for many losses from this cause. Spontaneous combustion can be reduced to a great extent by greater care in the drying of mowed products. The management of insurance companies can caution farmers to be more careful in the drying of these products, but the farmers themselves are directly responsible if they are careless in this respect.

Prices of farm products in relation to fire losses

In times of depression, losses from fires show a very considerable increase, especially for companies covering a wide territory. The moral hazard.

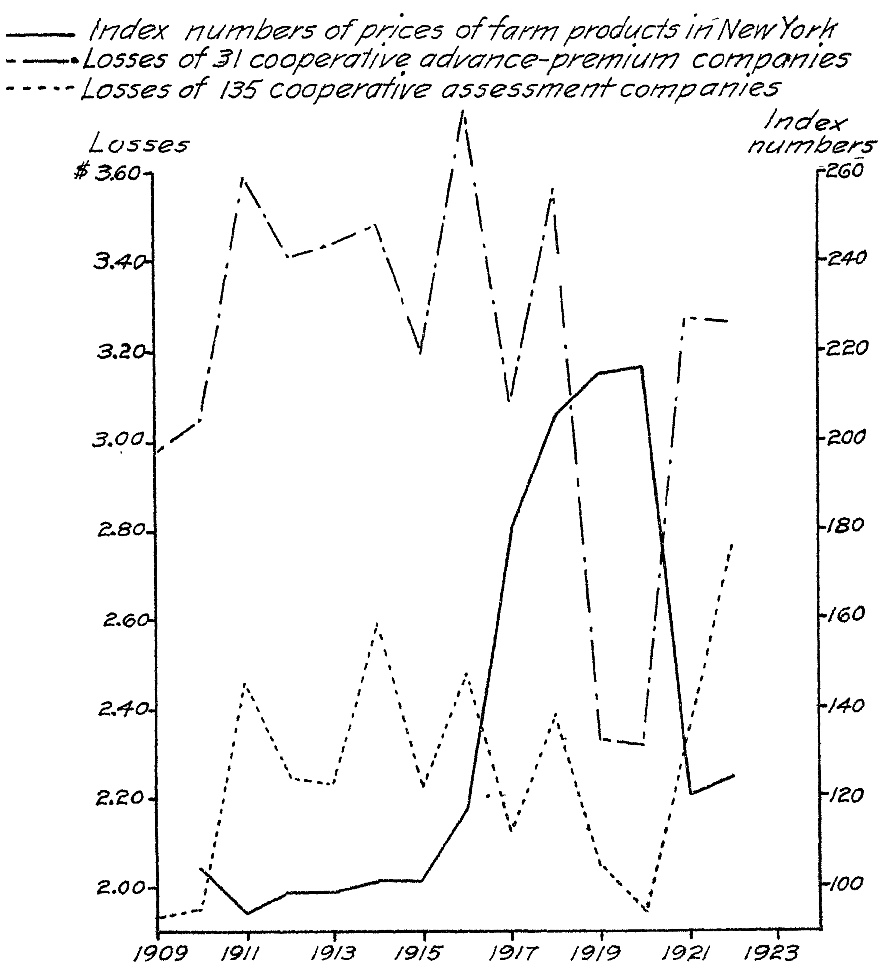

FIGURE 3. RELATION OF PRICES OF FARM PRODUCTS TO FIRE INSURANCE LOSSES

For index numbers of weighted averages of prices paid to producers of farm products in the United States used here, see Cornell University Agricultural Experiment Station Bulletin 416, Prices of Farm Products in New York, page 63

is greater for the advance-premium company, since the management is unable to maintain so close a watch on its risks as is possible in the assessment company, whose risks are largely confined to a limited territory. The moral hazard is also greatly increased by too high valuations.

The insurance costs of 1921–1922 were much higher than they had been in the preceding years. At the present time, the costs for all types of insurance companies are higher than they should be. One stock company has been paying two dollars for every dollar received from farm premiums during the past two years. Some cooperative advance-premium companies have been paying over one dollar and forty cents for each dollar received from premiums of their farm insurance. In both of these types of companies, premiums received from village and city risks during this period have been helping to pay the losses on farm property (figure 3). A comparison of the average annual losses of 31 cooperative advance-premium companies, of the average annual losses of 135 cooperative assessment companies, and of the prices of farm products in New York State, is shown in figure 3.

Land values in relation to fire losses

There is a direct relation between low land values and heavy fire losses: the losses of companies situated in counties having low land values average much higher than those in counties having high land values. This condition may be attributed to differences in types of farming, to greater moral hazards, to greater carelessness, and to negligence on the part of the property owners in these poorer regions.

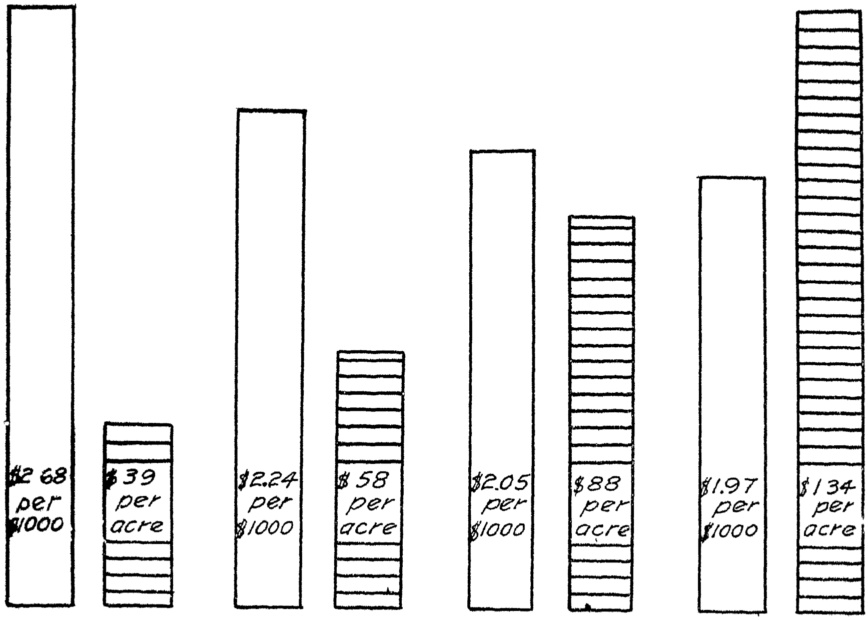

FIGURE 4. COMPARISON OF LOSSES IN 62 COUNTY ASSESSMENT COMPANIES, 1910–1922, WITH COUNTY VALUATIONS OF FARM LAND

Land values in dairy regions average less than those in crop regions, while there is usually a greater proportionate investment in buildings in the dairy regions. The necessity for the use of artificial light during much of the year, and of persons being in the buildings more frequently, in the care of livestock, increases the fire hazard. These conditions result in heavier losses in dairy regions.

The moral hazard is sometimes increased by certain changes in type of farming. Thru increased demand for truck crops, caused by growth in city population, some dairy farms have become truck farms. Dairy buildings used in a different type of farming may be worth only a small part of their previous value. The moral hazard is thus increased, unless valuations of buildings are reduced to correspond to their usefulness in the new type of farming.

TABLE 3. COMPARISON OF LOSSES IN 62 COUNTY ASSESSMENT COMPANIES WITH COUNTY VALUATIONS OF FARM LAND, 1910–1922*

Number of companies	Value per acre	Cost per $1000 insurance
8	$103 and over	$1.97
13	$73–$102	$2.05
26	$43– $72	$2 24
15	$26– $42	$2.68

* See Appendix G.

Regions of low land values are in general less prosperous than regions having higher land values. Land values in these poorer regions are not only low, but in general are still declining, and there is much sub-marginal land. Risks in such regions are likely to include greater moral hazards.

Probably the most frequent causes of fire losses are carelessness and negligence. An unprosperous farmer often becomes discouraged, and does not take such great precautions to reduce his fire hazards. A few farmers probably burn their buildings to obtain money from the insurance.

TABLE 4. LOSSES OF DIFFERENT TYPES OF COOPERATIVE COMPANIES, 1910–1922*

Number	Type of company	Average losses per $1000 insurance	Range in losses
31	Advance-premium	$3.17	$1.42–$6.47
41	County assessment (other than grange)	2.35	0.52– 5.93
28	Grange (patrons of husbandry)	2.11	1.18– 3.80
67	Town assessment	2.10	0.13– 5.39

* See Appendix F for advance-premium losses, Appendix H (1) for county assessment other than Grange, and Appendix H (2) for Grange losses, and Appendix C(5) for town assessment losses.

If the management of a cooperative company wishes to know whether its losses are too high, it should compare them with the losses of other companies operating in the same territory, and also with the average of

the losses of all companies. If the fire losses are excessive, they can be reduced by rejecting bad moral hazards among present policyholders; by reducing excessive valuations of property insured; by enforcing a more rigid inspection of risks; and by creating a greater mutual interest between the management and the policyholders thru the presentation of facts concerning the prevention of fire losses and the effects of these losses on the cost of insurance.

OPERATION OF COOPERATIVE FIRE INSURANCE COMPANIES

The cooperative fire insurance companies now in operation in New York State are of two general types, assessment companies and advance-premium companies. The assessment companies are truly cooperative, assessing their members at the end of each year for losses and expenses. Large reserves are not required, since these companies have excellent credit and can borrow to pay losses as they occur. As their name suggests, the advance-premium companies collect their premiums in advance on the insurance carried. While cooperative in form, these companies operate in much the same way as do stock companies, except that they have no capital stock on which to pay dividends.

Cooperative assessment companies

One of the chief advantages of a cooperative assessment company over other types of companies is the low expense of the business. The principal reasons why fire protection is obtained at low rates in such a company are that no commissions are paid to agents, that the expenses of running the business are generally low, and that the fire losses average much lower than in other types of companies.

Salaries and commissions constitute a large part of the expenses of companies in which the business is obtained entirely by agents. The greatest saving in the management costs of assessment companies is effected thru the voluntary contributions of insurance by the farmers. No agents are required to solicit the business. The annual management expense of assessment companies from 1910 to 1922 averaged $0.42 per $1000 insurance,[8] while the annual salaries and commissions of advance-premium companies averaged $1.50 per $1000 insurance.[9] The difference of $1.08 per $1000 insurance represents, largely, the saving effected by the assessment companies thru voluntary contributions of insurance and thru the saving in managerial and clerical salaries. In assessment companies, the majority of those directly carrying on the business devote only a small part of their time to this work. Officers of these companies often work for less than their actual worth, as measured by business standards of other corporations. In many companies, the farmer-directors inspect the risks and appraise new risks at times when they are not busy with their farm work. They can, therefore, afford to work for less compensation than would be necessary if they had no other source of income. Since assessment companies ordinarily have only a small reserve fund, there may be a greater tendency to economize in management expense than would be the case if they had a large surplus.

[8] See Appendix C(6).
[9] See Appendix D(5).

In general, the moral hazard is much less in cooperative assessment companies than in other types of fire insurance companies. Fire losses are lower because the risks are more carefully selected and because the risk from dishonest losses is less than in other types of companies. Individuals in a community are usually acquainted with the other policyholders in that community. If, thru a change in property values or for some other reason, an unscrupulous member becomes overinsured, his acquaintance with the other policyholders would deter him from occasioning a dishonest loss. He would know that thereafter his community would be an undesirable place for him to live if such a loss occurred, even tho no direct evidence could be brought against him. If such a man carried insurance in a stock company whose main office was far away, the situation would be much different.

In cooperative assessment companies there is no temptation to avoid the payment of losses because of technicalities. The companies are organized wholly for the benefit of their members. When there is any question as to the interpretation of a policy, the member suffering the loss usually is given the benefit of the doubt. In this way, sympathy can be expressed tangibly with only a slight expense to any one member. Next to the low cost of insurance, this liberality in interpreting contracts is probably the greatest advantage of cooperative farm fire insurance.

Rental expense in assessment companies is usually very low. Many companies are under no expense for this, because their managing officers use their private offices for performing the necessary duties. If a regular office is maintained, the rental is likely to be low, since the offices of the majority of these companies are located in the smaller towns.

The management of a cooperative assessment company has an interest in the affairs of its company not commonly found in a company organized for profit. This interest is something which cannot be measured in a tangible way. It is characteristic of individuals to give more in service when they thoroly believe in the organization which they are serving and when they have a real service to perform. Another reason why the management of a cooperative organization takes a very active interest is because it is responsible, not only to the directors, but also to the members. This sense of responsibility becomes very acute in the smaller communities, especially if anything goes wrong. In a company organized for profit, the management is responsible only to the directors. In a cooperative company, this responsibility extends in a very direct manner to the individual members.

The plan of cooperative assessment companies is to charge an assessment at the end of each year for the payment of losses sustained and expenses incurred during that year. In order to provide for prompt payment of these losses, money is borrowed to cover them soon after they have occurred. Notes are signed by the president and the secretary, as representatives of the incorporated company. Assessment companies usually maintain only a small reserve. Even without this, however, they have no trouble in borrowing sufficient money to cover all losses until the yearly assessments are paid. This shows the high rating given them by financial institutions. This rating is based on the sound business ability evidenced in the management of these companies and on the strict enforcement by

the State Insurance Department of the provisions provided for in the standard insurance law.

Assessment companies have very little trouble in the collection of premiums. Each director of an assessment company is assigned to a definite territory, and he looks after the company's business in that territory. A postal card stating the premium assessment is sent to each policyholder at the end of the business year. Assessments are paid to the directors in their respective territories, or are sent directly to the secretary of the company. Premiums remaining uncollected are so small as to be practically negligible.

Cooperative advance-premium companies

Approximately 80 per cent[10] of the insurance of cooperative advance-premium companies is written on village and city risks, and only about 20 per cent is written on farm property. This fact should be kept clearly in mind when comparing these companies with cooperative assessment companies, in which the major part of the insurance is on farm property.

Insurance in cooperative advance-premium companies is obtained entirely thru agents. Each company has a manager who directs the affairs of the company, including the appointment of agents. A reserve of at least 80 per cent of the unearned part of premiums charged to its policyholders must be maintained, while, in addition, a company may maintain a surplus, which, however, must not equal more than 1 per cent of the total amount of insurance.[11] This reserve and surplus must be invested in high-grade, readily marketable securities of the type permitted for savings banks. Agents look after the collection of premiums. From the total premiums they deduct 15 per cent for commission, and return the balance to the company. Agents are allowed a sixty-day period after premiums are due in which to pay them to the company.

The plan of operation of a cooperative advance-premium company is very similar to that of a stock company. The main difference between a stock insurance company and a cooperative advance-premium company is that the cooperative advance-premium company has no capital stock on which to pay dividends. Since they pay no dividends on stock, and sometimes operate at a lower expense, many advance-premium companies are able to give reliable insurance at a lower cost than do stock companies. Several companies, having reached the limit of cash surplus permitted by law, return dividends to policyholders at the expiration of policies. One feature peculiar to the plan of cooperative advance-premium companies is that interest earnings from such invested reserve and surplus funds as are held solely for the protection of the policyholders, under the provisions of the law, can be legally used only in payment of losses or returned to the policyholders. No provision is made for any redistribution of this reserve.

Of the 31 advance-premium companies operating in the State, 27 have specific classifications of risks. The length of the term of the policy in these companies depends on the class of property. Mercantile and

[10] Estimate of the Manager of the Co-operative Fire Underwriters Association of New York State, Albany, New York.

[11] New York State Co-operative Fire Insurance Law. 1909.

manufacturing stocks, fixtures, machinery, special hazards, such as explosives and highly inflammable materials, and buildings containing these hazards, are limited to a term of one year. Policies for household goods, dwellings, schoolhouses, churches, and municipal, county, and town buildings, are written for a three-years period.

Most cooperative advance-premium companies operate over a wide territory. The average territory is forty counties.[12] Since the operations of these companies extend over such wide areas, it is impossible for them to make such careful selections of risks as do the assessment companies, which in general cover more limited areas. Consequently, their losses are considerably greater.

COSTS OF COOPERATIVE ADVANCE-PREMIUM COMPANIES AND OF COOPERATIVE ASSESSMENT COMPANIES

Data on losses, expenses, and total insurance of each company were obtained from the annual reports of the New York State Superintendent of Insurance. The cost of insurance for each company, for the period 1910–1922, was computed by dividing the sum of losses and expenses by the total insurance written. The average cost of insurance for each group was obtained by dividing the sum of losses and expenses by the total insurance of all companies within the group.

TABLE 5. LOSSES AND EXPENSES OF 31 ADVANCE-PREMIUM COMPANIES, 1910–1922*

Cost per $1000 insurance	Number of companies	Average cost for group
$1.76–$2.75	3	$2 33
2.76– 3.75	3	3 34
3.76– 4.75	6	4.52
4 76– 5.75	12	5 29
5 76– 6 75	5	6 12
Over 6 76	2	9 82
Total	31	....
Weighted average†		$5.17

* See Appendix B for losses and expenses of each company.
† See Appendix D(4)

The average losses and expenses during the period 1910–1922, for 31 cooperative advance-premium companies, was $5.17 per $1000 insurance. This does not include the cost to the policyholders of the surplus[13] of $1,540,279 accumulated during this period, which averaged $.71 per $1000 insurance. Of the total disbursements,[14] 61 per cent was paid to the policyholders for losses or dividends; 29 per cent was used in paying salaries and commissions; and the remaining 10 per cent was used for miscellaneous expenses, including rent, interest, and legal expenses.

[12] In the Sixty-third annual report of the Superintendent of Insurance of the State of New York, part 4, 1922. Number of counties given for each company under "General interrogations."
[13] See Appendix F(2).
[14] See Appendix D(1), (2), (3).

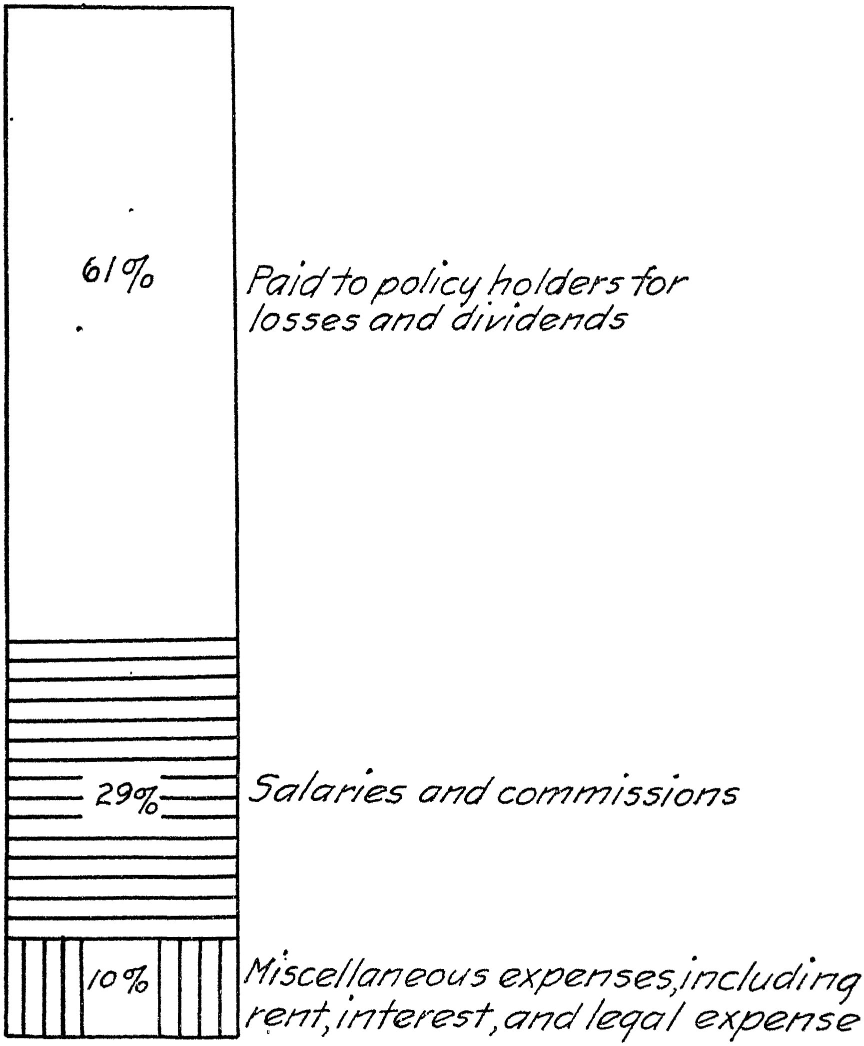

FIGURE 5. DISTRIBUTION OF EXPENDITURES OF ADVANCE-PREMIUM COMPANIES, 1910–1922

The average losses and expenses in cooperative assessment companies, for the period 1910–1922, was $2.75 per $1000 insurance. Of the total disbursements,[15] 81 per cent was paid to the policyholders for losses; 15 per cent was paid for salaries, fees, and clerk hire; and the remaining 4 per cent was paid for miscellaneous expenses including rent, interest, and legal expense. For the county assessment companies, the average amount of insurance was $2176 per policy.[16]

[15] See Appendix C.
[16] See Appendix C(7).

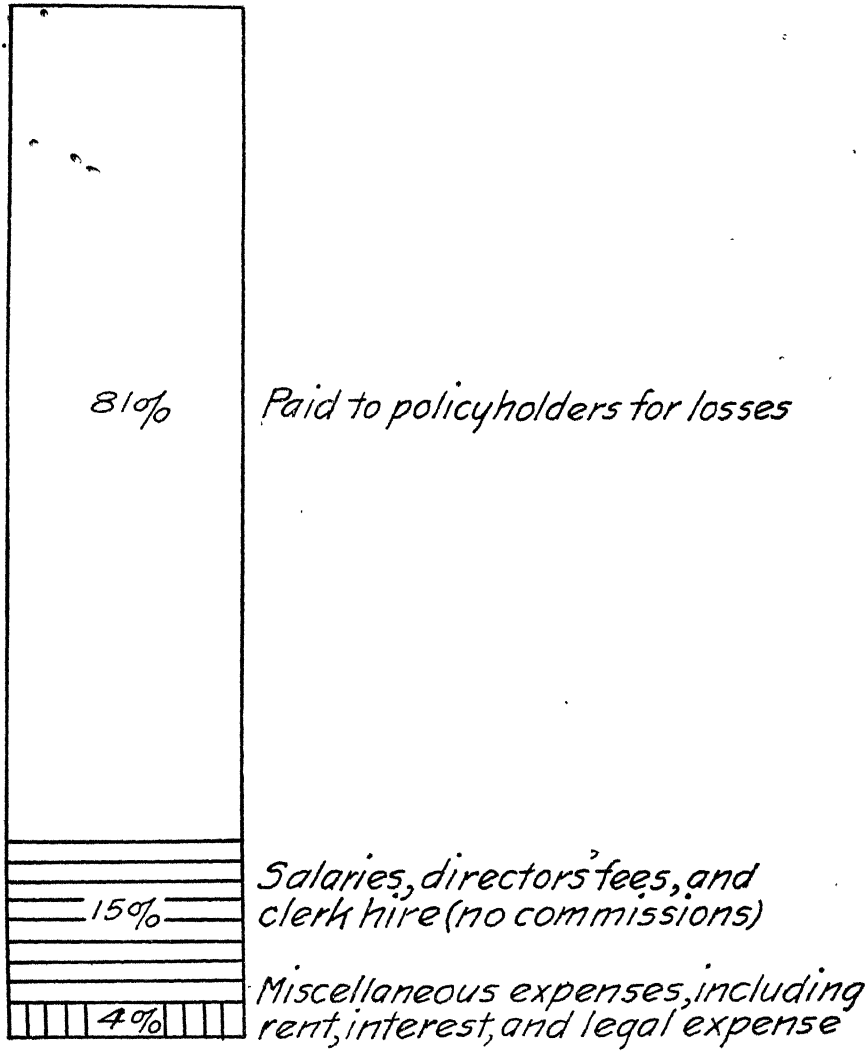

FIGURE 6. DISTRIBUTION OF EXPENDITURES OF COOPERATIVE ASSESSMENT COMPANIES, 1910–1922

When risks are confined to a small territory, as in a town assessment company, a saving is effected in the cost of the traveling expenses ordinarily incurred in appraising, inspecting, and adjusting. The average costs of town assessment companies over a period of years are less than for other types of companies. On the other hand, the yearly losses are more variable, and occasional large losses make necessary very large assessments. This is a disadvantage of the small company. In the larger companies, the risks are spread over a large membership, and are less variable. County

TABLE 6. LOSSES AND EXPENSES OF 135 ASSESSMENT COMPANIES, 1910–1922*

Cost per $1000 insurance	Number of companies	Average cost per $1000 insurance
Under $1.51	12	$1.35
$1.51–$2.00	15	1.80
2.01– 2.50	36	2.27
2.51– 3.00	27	2.73
3.01– 3.50	20	3.26
3.51– 4.00	12	3.73
4.00 and over	13	4.95
Total	135	....
Weighted average†		$2.75

* See Appendix A for the losses and expenses of each assessment company.
† See Appendix C(4).

companies write 86 per cent,[17] and town companies 14 per cent, of the total insurance of cooperative assessment companies.

ORGANIZATION OF A COOPERATIVE FIRE INSURANCE COMPANY

The chief purpose of a cooperative fire insurance company is to give its members reliable protection at minimum cost. To accomplish this, the company must promote energetically the elimination of preventable losses. The burden of the losses which cannot be prevented should be distributed on an equitable basis. To reduce the moral hazard as much as possible, risks are usually limited by the different companies to two-thirds or four-fifths of the valuation of the property insured. The purpose of this is to require the owner to bear a reasonable part of any loss sustained, thus making it to his interest, above all others, to have his property remain in existence.

A company is usually formed under the auspices of some other organization in the community. Twenty-nine county cooperative companies formed under the auspices of the Grange are now in operation. The territory in which the business of these companies is transacted is usually confined to less than five counties.

The first step[11] in the organization of a cooperative company is for thirty or more persons who are owners of real estate to sign a pledge stating the valuation of the property to be insured. Altogether, this must equal not less than $50,000. In order to become a corporation, declarations must be filed with the State Superintendent of Insurance, and the applicants must comply with the regulations included in the insurance law. These regulations require applicants to state (1) whether the corporation will do business as a town, a county, or an advance-premium corporation; (2) the territory in which it intends to do business, and the place in which the principal office is to be located; (3) its corporate name, which must include the word "cooperative"; (4) the by-laws adopted for the regula-

[17] Sixty-fourth annual report of the Superintendent of Insurance of the State of New York, part 4, 1923. County assessment Companies, $473,336,207 insurance; town assessment companies, $69,806,277 insurance.

tion of the business of the corporation; (5) the names and addresses of the officers and directors for the first year; (6) any other information that may be required by the superintendent of insurance.

When the pledges have been signed, directors are elected. A town corporation must have at least five directors, and a county or advance-premium corporation at least eleven. From their number the directors elect officers, which must include at least a president and a secretary. Often one person is both secretary and treasurer. The officers are chosen for periods of one to four years, as the by-laws of the corporation may prescribe. The directors are often divided into classes, so that only a part of them are elected each year. The directors exercise the powers of a corporation, and transact business in accordance with the by-laws. The by-laws must designate the number of directors to constitute a quorum. The officers who handle the money of the corporation must be bonded. The directors draw up the articles of incorporation and the by-laws, usually with the help of an attorney.

After becoming incorporated, all those who have signed pledges must fill in an application for insurance on a blank provided. When an applicant has been accepted, he is given a policy. In each application is a clause in which the insured guarantees to pay his *pro rata* share of all losses or damages sustained by any member of the company. In assessment companies, the director who lives in the locality determines the amounts for each policy. In these companies no risk can exceed $7000. In selecting risks, the character of the owner, as well as the physical condition of the property, is considered. Applicants known to be dishonest or thriftless are rejected. The final judgment of amounts and persons eligible is left with the president or manager of the company. In advance-premium companies all risks are divided into classes, with specific rules governing each class. No policy can exceed $15,000 on any one block or square in a city, or more than $5000 on a risk in any other class of insurance. A company becomes a legal corporation after the minimum insurance has been subscribed.

The blanks for application for insurance are held by the company. Policies run from three months to five years, the majority of them being written for terms of three or five years. The length of term depends on the company and on the class of insurance. A standard policy approved by the State Insurance Department is used by all companies. The New York standard mortgagee clause allows for payment to a person other than the party holding the policy, in case of loss or damage under the policy. This clause provides protection for mortgage holders who care to use it.

SUMMARY

Cooperative fire insurance companies in New York State represent one of the best examples of successful farmer cooperation over a period of years. On January 1, 1923, there were 166 such companies in the State, operating in fifty-eight counties. At that date, these companies, together, had 415,132 policies and $787,096,293 insurance in force. Seventy-two per cent of this total insurance is (1923) written by assessment companies, in which the major proportion of the insurance is on farm property

Of the total insurance on insurable farm property in the State, approximately 90 per cent[18] is (1923) written by cooperative companies.

The cooperative fire insurance companies now in operation in New York State are of two general types, assessment companies and advance-premium companies. The assessment companies assess their members at the end of each year for their losses and expenses. They do not carry large reserves, but borrow to pay losses as they occur. The cooperative advance-premium companies collect their premiums in advance on the insurance carried. These companies operate in much the same way as do stock companies, except that they have no capital stock on which to pay dividends.

The assessment companies now active in this State have averaged forty years of operation. Since the risks in these companies are scattered, the companies are in no danger from great conflagrations such as can occur in cities. Of the total insurance of cooperative companies, 60 per cent is (1923) written by county assessment companies. County assessment companies are probably the most satisfactory type of companies writing farm insurance, since the costs for losses and expenses are lower than in cooperative advance-premium companies or stock companies, and since, in general, losses are less variable than in the smaller, town assessment companies.

Losses are greater in counties having low land values than in those having high land values. This condition may be attributed to differences in types of farming, to greater moral hazards, to greater carelessness, and to negligence on the part of the property owners in these poorer regions. Excessive costs can be reduced by rejecting bad moral hazards among the present policyholders; by reducing valuations that are too high; by enforcing a more rigid inspection of risks; and by creating greater mutual interest between the management and the policyholders, thru the presentation of the facts concerning fire losses and their payment.

The success of cooperative fire insurance companies is based on the fact that they have given their members reliable insurance at reasonable costs. Savings have been effected in assessment companies thru voluntary contributions of insurance and thru saving in managerial and clerical salaries. Fire losses in these companies are lower than in other types of companies, because the risks are more carefully selected, and, as a result, risk from dishonest losses is less. The low cost encourages farmers to use these companies without being urged, and since no agents are required to solicit insurance, this results in a still lower cost.

Next to the low cost of insurance, liberality in interpretation of contracts is probably the greatest advantage of cooperative farm fire insurance. When there is any question as to the interpretation of a policy, the member suffering the loss is usually given the benefit of the doubt.

CONCLUSION

The greatest asset of the assessment companies is their "good will." This has been created by their giving their members a square deal at all times, and a complete knowledge of the facts connected with their business plans and practices. This frankness and complete lack of concealment

[18] Estimate of two experienced insurance officials.

have resulted in making the members feel that they are truly a part of their particular company, and in return they back the management with their confidence.

Cooperative farm fire insurance companies were organized in response to a real need. The reasons for this need may be attributed, during the early history of the companies, to the excessive insurance costs of stock companies of that time; to the uncertainty of the protection because of the instability of some of the companies then writing farm insurance; and to the fact that it was then possible for insurance companies to include certain technicalities in their policies that enabled them to evade the payment of honest losses.

The managements of the cooperative assessment companies are composed of the best type of farmers. In solving the problems of these companies, the officers use the same keenness of judgment that characterizes their own business dealings. They are not working merely for wages, but are interested as members receiving the service given. This personal interest is an incommensurable asset.

The membership of these companies is relatively stable. Each company has been originated by those who become active members. The policies and the practices are known and understood, even tho the present membership may be entirely different from the charter membership. Since these companies operate in restricted areas, it is possible for the members of each company to know the management personally.

Cooperative farm fire insurance companies have pursued definite, long-time business policies which have proved economically sound. The business policies of assessment companies at the present time are substantially the same as those in force seventy years ago.

APPENDICES

APPENDIX A

LOSSES AND EXPENSES OF 135 COOPERATIVE ASSESSMENT COMPANIES

The data for the losses and expenses of 135 cooperative assessment companies were obtained from the annual reports of the New York State Superintendent of Insurance (part 4 of each report) for the period 1910–1922, for each company. Data in these insurance reports are for the year preceding that for which the reports are listed. For example, the 1910 report includes data for the business year of 1909. Data in the following appendices are listed for the same year as the insurance report from which they were taken. An example of the data is shown in the following tabulation:

Year	Total payments to policy-holders for losses	Total losses and expenses	Balance on hand at beginning of year	Number of policies in force	Total amount of insurance
	(a)	(b)	(c)	(d)	(e)
1910	$13,437	$15,305	$1,216	2,808	$5,190,000
1911	11,016	13,652	1,054	2,931	5,129,000
1912	10,726	13,471	785	2,876	5,237,000
1913	15,633	19,360	98	2,866	5,340,000
1914	23,991	27,491	977	2,812	5,510,000
1915	26,475	31,721	401	2,834	5,661,000
1916	17,924	23,264	101	2,808	5,888,000
1917	17,563	21,175	342	2,790	6,068,000
1918	24,125	29,935	782	2,585	6,229,000
1919	24,396	30,536	1,815	2,602	6,347,000
1920	14,099	19,813	2,422	2,734	6,643,000
1921	16,713	23,212	1,247	2,769	7,282,000
1922	17,469	23,854	181	2,778	7,708,000
Total	$233,567	$292,789	$11,421	36,193	$78,232,000

If "Returns to policyholders other than loss payments" or "Borrowed money repaid" items were included under disbursements, these items were subtracted to obtain the "Total losses and expenses" of column *b*. Interest on borrowed money was included as an expense.

The proportion of the money returned to policyholders for losses to the money paid by policyholders as assessments for insurance was obtained by dividing the total of payments for losses by the total assessments paid. In the preceding example, $233,842 was divided by $292,789, which gives 80 per cent.

The average losses and expenses per $1000 insurance was obtained by dividing the total of losses and expenses by the thousands of dollars of insurance in force. In the preceding example, $292,789 was divided by 78,232, which gives $3.74 as the average cost per $1000 insurance for losses

and expenses. The average losses per $1000 insurance were computed in a similar manner. The amount of $233,567 was divided by 78,232, which gives losses of $2 99 per $1000 insurance.

The average expenses per $1000 insurance were obtained by subtracting the average of losses from the average losses and expenses. Thus, in the foregoing example, $3.74 minus $2.99 equals $.75 for average expenses per $1000 insurance for the period 1910–1922.

The losses and expenses of each of 135 cooperative assessment companies are shown in the following table:

Name of company	Proportion of losses to total losses and expenses (per cent)	Average losses per $1000 insurance	Average expenses per $1000 insurance	Total losses and expenses per $1000 insurance
Otsquago	31	$0 13	$0 29	$0 42
Farmers Mutual of Rhinebeck	81	0 89	0 21	1.10
Hebron	86	1.02	0 16	1 18
Putnam	83	1 10	0 21	1 31
Springfield	77	1 03	0 30	1 33
Farmers of Minden	85	1 15	0.21	1 36
Delhi	77	1 05	0 32	1 37
Venice	84	1 16	0 22	1 38
Franklin	77	1.08	0 31	1.39
Amherst and Clarence	62	0.89	0 54	1.43
Butternut	77	1 13	0 34	1 47
Ballston	87	1 31	0 19	1.50
Davenport	77	1 22	0 36	1 58
Mohawk Valley	74	1 23	0 43	1.66
Bovina	88	1 47	0 20	1 67
Dwelling House of Cayuga County	31	0 52	1 15	1 67
Cambridge	86	1 49	0 24	1.73
Jefferson County	76	1 34	0 43	1 77
White Creek	90	1 62	0 19	1 81
Oneida County	65	1 18	0 64	1.82
Claverack	84	1 54	0 30	1.84
Walton	79	1.46	0 40	1 86
Caroline	73	1 37	0 51	1.88
Westmoreland	76	1 46	0 45	1.91
Knox	84	1 62	0 31	1.93
Germantown and Clermont	64	1.27	0 70	1 97
Charlton	89	1 76	0 23	1.99
Cooperative of Hartford	87	1 75	0 26	2.01
German Mutual of Wayland	89	1 81	0 23	2.02
Monroe Patrons	89	1 79	0 23	2.04
Meredith	86	1 74	0 30	2.04
Argyle	89	1 83	0 22	2.05
Jackson	89	1 84	0 22	2.06
Pittstown	83	1 76	0 36	2 12
Cayuga Patrons	84	1 79	0 35	2.14
Farmers of Palatine	80	1.73	0 43	2.16
Andes	81	1 75	0 42	2.17
Greenwich	90	1.96	0.22	2 18
Ulster	88	1 92	0 26	2.18
Hoosick	85	1.85	0 33	2.18
Orleans County	80	1.76	0.43	2.19
Tompkins, Schuyler, Tioga Patrons	76	1.66	0.53	2.19

Name of company	Proportion of losses to total losses and expenses (per cent)	Average losses per $1000 insurance	Average expenses per $1000 insurance	Total losses and expenses per $1000 insurance
Cooperative of Granville	82	$1 82	$0 40	$2.22
Cayuga County	76	1 70	0 52	2.22
Dryden and Groton	75	1 67	0 55	2 22
Fire Relief of Wayne	89	1 98	0 26	2 24
Patrons of Herkimer	80	1.80	0.46	2 26
Broome Patrons	78	1.76	0 51	2 27
Farmers Fire of Greenville	69	1 57	0.71	2 28
Farmers of Hyde Park	89	2 04	0 24	2 28
Farmers Mutual of Cayuga	76	1.75	0 54	2.29
Hartwick	80	1.81	0 49	2.30
Hamden	89	2 04	0 26	2.30
Chautauqua Patrons	84	1 98	0 37	2.35
Middletown and Roxbury	82	1 96	0 41	2 37
Cherry Valley and Roseboom	68	1 61	0.77	2.38
Galway	91	2.18	0 21	2.39
Easton	87	2 10	0 30	2.40
Genesee Patrons	85	2 06	0 37	2 43
Farmers of Orleans and Niagara	82	2 01	0 42	2.43
Farmers of Clay, Camillus	78	1 92	0 54	2.46
Sharon, Seward and Carlisle	76	1 87	0 59	2.46
Kortright	92	2 31	0 19	2.50
Patrons of Cortland	82	2 07	0 45	2.52
Onondaga Patrons	77	1.97	0 58	2.55
Sauquoit Valley	84	2 16	0.40	2.56
Erie and Niagara Counties	81	2 08	0 49	2.57
Schoharie and Schenectady	77	1 99	0.59	2.58
Madison-Onondaga	79	2 06	0 54	2.60
German-American of Niagara	72	1.89	0.73	2.62
Farmers of Oneida	79	2 08	0 55	2.63
Cortland Patrons	85	2 25	0 39	2 64
Patrons of Seneca	89	2 37	0 30	2.67
Otsego Patrons	88	2 36	0 32	2.68
Broome County	74	1 99	0.70	2.69
Chenango Patrons	78	2 13	0.59	2.72
Ontario Patrons	85	2 35	0.40	2.75
St. Lawrence Patrons	85	2.32	0 43	2.75
Crown Point	84	2 33	0.43	2.76
Patrons of Madison	82	2.27	0.49	2 76
Ashford	81	2 27	0 55	2 82
Montgomery and Fulton Patrons	77	2.17	0.66	2.83
Niagara and Erie	69	1 95	0 88	2.83
Farmers of Ft. Ann	87	2.48	0.36	2.84
Lutheran Mutual of Wellsville	86	2.45	0 40	2.85
Livingston	87	2 53	0.33	2.86
Salem Mutual	92	2.69	0.22	2 91
Erie County Fire Relief	80	2 35	0.58	2.93
Farmers of Ft. Edward	90	2.66	0 29	2.95
Patrons of Steuben and Livingston	88	2 64	0.35	2.99
Farmers of Clinton	90	2.70	0 32	3.02
Dutchess and Columbia Patrons	88	2.68	0.35	3.03
Fire Relief of Oswego	84	2.57	0.48	3.05
Rensselaer County	79	2.43	0.65	3.08
Farmers of Pompey and Fabius	89	2.82	0.34	3.16
Cooperative of Wyoming and Genesee	61	1.96	1.25	3.21

Name of company	Proportion of losses to total losses and expenses (per cent)	Average losses per $1000 insurance	Average expenses per $1000 insurance	Total losses and expenses per $1000 insurance
Farmers of Catskill	68	$2.22	$1.02	$3.24
Tioga County	85	2.78	0.48	3.26
Otsego County	70	2.28	0.99	3.27
Callicoon of Sullivan	85	2.77	0.50	3.27
St. Lawrence	80	2.64	0.67	3.31
Schaghticoke	93	3.11	0.23	3.34
Westchester and Putnam Patrons	64	2.14	1.21	3.35
New Scotland	91	3.06	0.29	3.35
Stamford	86	2.91	0.49	3.40
Clifton Park and Half Moon	84	2.88	0.54	3.42
Farmers of Red Hook	87	2.97	0.45	3.42
Fulton and Montgomery Counties	87	2.98	0.45	3.43
Clinton County Patrons	81	2.78	0.67	3.45
Farmers of Chemung, Schuyler and Yates	86	3.00	0.47	3.47
Cattaraugus County Patrons	86	3.05	0.49	3.54
Delaware Patrons	86	3.05	0.50	3.55
Bethlehem	81	2.96	0.67	3.63
Saratoga	78	2.86	0.83	3.69
Colonie	92	3.42	0.29	3.71
Farmers of Milan	87	3.24	0.50	3.74
Allegany	80	2.99	0.75	3.74
Patrons Onondaga and Oswego	65	2.44	1.31	3.75
American Sullivan	49	1.85	1.91	3.76
Wilton	86	3.24	0.54	3.78
Malta	90	3.44	0.38	3.82
Cattaraugus Farmers	82	3.13	0.70	3.83
Ontario County	74	2.98	1.05	4.03
Ghent	94	3.82	0.24	4.06
Coeymans	95	3.94	0.21	4.15
Farmers of Steuben	81	3.41	0.81	4.22
Mutual Nassau, Schodack and Chatham	83	3.69	0.74	4.43
Wyoming Patrons	80	3.80	0.93	4.73
Suffolk and Nassau Patrons	80	3.89	0.95	4.84
New Baltimore	89	4.57	0.58	5.15
Fidelity	65	3.36	1.80	5.16
Guilderland	90	4.81	0.56	5.37
Brunswick	93	5.39	0.43	5.82
Danby Cooperative	88	5.92	0.84	6.76
Cooperative of Sullivan	71	5.93	2.36	8.29

APPENDIX B

LOSSES AND EXPENSES OF 31 COOPERATIVE ADVANCE-PREMIUM COMPANIES

The methods used for the calculations of the losses and expenses of 31 cooperative advance-premium companies are similar to those used in Appendix A. Data were obtained from the annual reports of the New York State Superintendent of Insurance (part 4 of each report) for the period 1910–1922. The figures are shown in the following table:

Name of company	Proportion of losses to total losses and expenses (per cent)	Average losses per $1000 insurance	Average expenses per $1000 insurance	Total losses and expenses per $1000 insurance
Woodstock	70	$1.42	$0.61	$2 03
Church	94	2 04	0 13	2.17
Olive	74	2 04	0 70	2.74
Livingston	76	2 38	0.74	3.12
West Seneca	60	2 01	1 36	3 37
Patrons of Ulster	64	2 35	1.33	3 68
Protective	38	1 56	2 53	4 09
Wyoming Valley	65	2.83	1 49	4.32
Preferred Mutual of Chenango	56	2 43	1 92	4 35
Lancaster Mutual	27	1 23	3 36	4.59
Sterling	56	2 64	2.07	4.71
Monroe	61	2 89	1.86	4 75
Pioneer	60	2 89	1 92	4.81
Security of Delaware	59	2.84	2 01	4.85
Merchants and Farmers of Schoharie and Albany	56	2 90	2 24	5.14
Tompkins	71	3.70	1 48	5.18
Greene County	60	3 10	2 09	5 19
Safety Cooperative	56	2 96	2 32	5.28
Cooperative of Greene, Schoharie and Delaware	59	3 24	2 26	5.50
New York Central Mutual	60	3.32	2 25	5.57
Utica Fire	58	3 24	2 38	5.62
Commercial of Greene	61	3.45	2 17	5 62
Catskill Mountain Fire	58	3 30	2 38	5.68
Empire Cooperative	59	3 37	2.33	5 70
Otsego Mutual	63	3 78	2 20	5 98
Chemical Mutual	60	3 79	2 50	6.29
Dwelling House of Central New York	45	2 87	3.46	6 33
Home of Broome	56	3.60	2 86	6 46
Oneida Cooperative	54	3 64	3 07	6 71
Canton	67	6.47	3.16	9 63
Merchants Cooperative of Central New York	52	5 82	5 44	11.26

APPENDIX C

DISTRIBUTION OF LOSSES AND EXPENSES OF 135 COOPERATIVE ASSESSMENT COMPANIES, 1910–1922

Data of losses and expenses of 135 cooperative assessment companies, from 1910 to 1922, for each year, were obtained from tables *F* and *J* of the annual report of the New York State Superintendent of Insurance (part 4 of each report). Data for "Insurance in force" were obtained from tables *G* and *H* of these reports.

In calculating the average losses, the summation of the total amount of losses from both county and town assessment companies was obtained, and this sum was divided by the summation of the totals of insurance in force, in thousands of dollars, to obtain the average loss per $1000 insurance. Thus, $11,153,695 divided by 4,975,532 gives an average loss of $2.24 per $1000 insurance for all assessment companies.

The total losses and expenses equal the total disbursements less borrowed money repaid. Thus, $18,481,542 less $4,779,266 gives $13,702,276, the total losses and expenses.

The management costs were obtained by adding the totals of officers' salaries, directors' fees, office expenses, application and survey fees, and expenses of adjustments. This total, divided by the total losses and expenses, gave the percentage of management cost. Thus $2,079,292 divided by $13,702,276 gives 15 as the percentage of management cost.

The total losses divided by the total losses and expenses gave the percentage of money returned to policyholders in payment of losses. Thus $11,153,695 divided by $13,702,276 gives 81 as the percentage of money returned to policyholders in payment of losses.

The payment of losses (81 per cent) plus the management costs (15 per cent) equals 96 per cent. Rent, interest, and miscellaneous expenses make up the remaining 4 per cent.

The total management cost equals $686,852 plus $336,510 plus $171,457 plus $159,264 plus $725,207, or $2,079,290.

(1) The total losses and expenses equals $18,481,542 minus $4,779,266, or $13,702,276.

(2) The total losses and expenses for management costs equals $2,079,290 divided by $13,702,276, or 15 per cent.

(3) The total losses and expenses returned to policyholders for losses equals $11,153,593 divided by $13,702,276, or 81 per cent.

(4) The ratio of losses and expenses to total insurance equals $13,702,276 divided by 4,975,532, or $2.75 per $1000 insurance.

(5) The average loss of 66 cooperative town assessment companies equals $1,520,682 divided by 722,842, or $2.10 per $1000 insurance.

(6) The cost of management expense equals $2,079,290 divided by $4,975,532, or $0.42 per $1000 insurance.

(7) The average amount per policy for county assessment companies equals $4,252,690,000 divided by 1,954,461, or $2176.

The distribution of losses and expenses of 135 cooperative assessment companies, from 1910 to 1922, is shown tabularly as follows:

	Total losses paid	Officers' salaries	Directors' fees	Office expenses and so forth	Expenses of adjustment	Application fees	Borrowed money repaid	Total disbursements	Number of policies in force	Total insurance
69 County companies..........	$9,633,013	$629,635	$290,071	$159,941	$144,758	$637,295	$4,490,648	$16,399,088	1,954,461	$4,252,690,000
66 Town companies...........	1,520,682	57,217	46,439	11,516	14,506	87,912	288,618	2,082,542	. . . .	722,842,000
Sum of totals................	$11,153,695	$686,852	$336,510	$171,457	$159,264	$725,207	$4,779,266	$18,481,630	. . . . .	$4,975,532,000

APPENDIX D

DISTRIBUTION OF LOSSES AND EXPENSES OF 31 COOPERATIVE ADVANCE-PREMIUM COMPANIES, 1910–1922

The distribution of losses and expenses of 31 cooperative advance-premium companies, from 1910 to 1922, is shown tabularly as follows:

Total losses paid	Commissions	Salaries	Total disbursements	Number of policies	Total insurance
$6,821,409	$2,168,308	$1,070,835	$11,139,443	1,970,443	$2,156,967,000

The total of salaries and commissions equals $2,168,308 plus $1,070,835, or $3,239,143.

(1) The percentage of total losses and expenses for salaries and commissions equals $3,239,143 divided by $1,139,443, or 29 per cent.

(2) The percentage of total losses and expenses returned to policyholders for losses equals $6,821,409 divided by $11,139,443, or 61 per cent.

(3) The payments for losses (61 per cent) plus the management costs (29 per cent) equal 90 per cent. Rent, interest, and legal and miscellaneous expenses make up the remaining 10 per cent.

(4) The ratio of total losses and expenses to insurance equals $11,139,443 divided by 2,156,967, or $5.17 per $1000 insurance.

(5) The ratio of salaries and commissions to insurance equals $3,239,143 divided by 2,156,967, or $1.50 per $1000 insurance.

(6) The average amount of insurance per policy equals $2,156,967,000 divided by 1,970,443, or $1100.

(7) The ratio of losses to insurance equals $6,821,409 divided by 2,156,967, or $3.16 per $1000 insurance.

APPENDIX E

APPENDIX E. AVERAGE ANNUAL LOSSES IN 135 COOPERATIVE ASSESSMENT COMPANIES

The average annual loss per $1000 insurance of 135 cooperative assessment companies was obtained by dividing the total losses for each year by the thousands of dollars of insurance in force for that year. In 1910, this equaled $1.93 per $1000 insurance. The total losses were obtained from tables *F* and *J*, and the total insurance in force from tables *G* and *H* of the annual reports of the New York State Superintendent of Insurance (part 4 of each report), 1910–1923. The losses and the total insurance from the 1923 report are included in this tabulation, but not in the tabulation of Appendix C.

The average annual losses in 135 cooperative assessment companies may be expressed tabularly as follows.

Year	Total losses	Total insurance in force	Average loss per $1000
1910	$253,585	$131,229,000	$1.93
1911	599,765	306,894,000	1.95
1912	840,976	341,661,000	2.46
1913	787,102	351,691,000	2.24
1914	806,262	362,289,000	2.23
1915	963,947	373,826,000	2.58
1916	861,506	387,259,000	2.22
1917	990,672	400,799,000	2.47
1918	870,870	413,542,000	2.11
1919	1,030,967	433,423,000	2.38
1920	937,108	458,869,000	2.04
1921	952,563	493,650,000	1.93
1922	1,258,372	520,400,000	2.42
1923	1,503,314	543,142,000	2.77
Total	$12,657,009	$5,518,574,000	......
Weighted average	......	......	$2.29

APPENDIX F

AVERAGE ANNUAL LOSSES AND ACCUMULATED SURPLUS OF 31 COOPERATIVE ADVANCE-PREMIUM COMPANIES

(1)

The "Total losses" were obtained from table *B*, and the "Insurance in force" from table *C*, of the annual reports of the New York State Superintendent of Insurance (part 4 of each report), 1910–1923. The losses and the total insurance from the 1923 Report are included in this tabulation, but not in the tabulation of Appendix D.

(2)

The surplus accumulated, from 1910 to 1922, in 31 cooperative advance-premium companies was as follows:

Total surplus, January 1, 1922	$2,159,830
Total surplus, January 1, 1910	619,551
Surplus accumulated in the 13-years period ...	$1,540,279

The average annual losses of 31 cooperative advance-premium companies are shown in the following table:

Year	Total losses	Total insurance in force	Average loss per per $1000
1910	$458,333	$154,027,000	$2.98
1911	459,340	150,369,000	3 05
1912	554,294	154,263,000	3 59
1913	543,083	159,352,000	3 41
1914	550,084	159,983,000	3 44
1915	540,943	155,854,000	3.47
1916	490,258	153,109,000	3 20
1917	569,497	152,243,000	3.74
1918	474,189	153,975,000	3 08
1919	569,659	159,550,000	3.57
1920	406,448	175,140,000	2.32
1921	475,649	206,040,000	2.31
1922	729,632	223,062,000	3.27
1923	794,533	243,954,000	3 26
Total	$7,615,942	$2,400,921,000	....
Weighted average	....	....	$3.17

The sum of the amounts of insurance carried each year during this period is $2,156,967. The ratio of accumulated surplus to insurance equals $1,540,279 divided by $2,156,967, or $.71 per $1000 insurance. The contributions to the surplus thus amounted to $.71 per $1000 insurance per year, on the average. This represents a part of the premiums paid by the policyholders, but has been omitted in figuring the cost of insurance.

APPENDIX G

COMPARISON OF LOSSES IN 62 COUNTY ASSESSMENT COMPANIES, 1910–1922, WITH COUNTY VALUATIONS OF FARMS

Farm values per acre for each county were obtained from the Fourteenth Census of the United States (Agriculture), 1920, volume 6, part 1, page 210, and county insurance companies were arbitrarily placed in groups, according to the land values of the counties included. When a company operated in more than one county, a simple average was made for the farm values in these counties. The average loss per $1000 insurance was obtained by dividing the total losses by the thousands of dollars of insurance in force for the companies in each class.

The tabulation of group 1 is as follows:

Companies	Value of farms per acre	Total losses of each company, 1910–1922	Total insurance in each company, 1910–1922
Delaware Patrons	$35	$65,362	$21,444,000
Chenango Patrons	38	217,628	102,240,000
Tioga Patrons	38	179,745	64,697,000
Farmers of Steuben	40	141,796	41,538,000
Patrons of Steuben	40	206,606	78,341,000
Otsego Patrons	40	37,992	16,070,000
Otsego County	40	153,789	67,543,000
Fidelity	41	184,982	55,110,000
Allegany	41	233,567	78,232,000
Saratoga	41	52,337	18,272,000
Farmers Mutual of Catskill	41	20,117	9,076,000
Mutual of Nassau (Rensselaer County)	42	54,425	14,752,000
Fulton and Montgomery	42	273,617	91,773,000
Rensselaer	42	291,158	119,997,000
Montgomery and Fulton	42	37,568	17,277,000
Total	....	$2,150,689	$796,362,000

Group 1 includes 15 county companies whose land values range from $26 to $43 per acre.

The ratio of losses to insurance of companies in this group equals $2,150,689 divided by 796,282, or $2.68 per $1000 insurance.

Counties included in group 1 are Allegany, Delaware, Essex, Franklin, Fulton, Greene, Hamilton, Lewis, Otsego, Rensselaer, Saratoga, Schoharie, Steuben, Tioga, Warren, and Washington.

Group 2 includes 26 county companies whose land values range from $43 to $72 per acre.

The ratio of losses to insurance of companies in this group equals $3,755,562 divided by 1,677,169, or $2.24 per $1000 insurance.

Counties included in group 2 are Albany, Broome, Cattaraugus, Chemung, Clinton, Columbia, Cortland, Herkimer, Jefferson, Madison, Montgomery, Oneida, Oswego, St. Lawrence, Schenectady, Schuyler, Sullivan, Tompkins, and Wyoming.

The tabulation of group 2 is as follows:

Companies	Value of farms per acre	Total losses of each company, 1910–1922	Total insurance in each company, 1910–1922
Clinton Patrons	$44	$181,700	$65,450,000
Farmers Reliance Chemung, Schuyler and Yates	45	507,607	169,310,000
Broome Patrons	47	31,991	18,133,000
Broome County	47	67,320	33,869,000
Tompkins, Schuyler Patrons	48	95,424	57,601,000
Patrons of Cortland	48	24,868	12,034,000
Cortland Patrons	48	108,719	48,382,000
Cattaraugus Farmers	49	292,464	93,475,000
Cattaraugus Patrons	49	90,806	29,747,000
St. Lawrence County	49	442,421	167,421,000
St. Lawrence Patrons	49	396,314	170,571,000
Schoharie and Schenectady	50	203,227	102,241,000
Farmers Fire Greenville	50	43,369	27,584,000
Cherry Valley, Roseboom	54	32,758	20,371,000
Patrons of Herkimer	54	109,425	60,907,000
Fire Relief of Oswego	54	242,634	94,382,000
Farmers of Minden	55	22,196	19,239,000
Mohawk Valley	55	3,838	3,124,000
Jefferson Patrons	55	312,934	233,291,000
Callicoon of Sullivan	56	154,383	55,681,000
Westmoreland	58	61,629	42,172,000
Oneida Grange	58	5,615	4,752,000
Farmers of Oneida	58	159,172	76,591,000
Sauquoit Valley	58	116,162	53,712,000
Patrons of Madison	59	27,524	12,112,000
Wyoming Patrons	65	19,062	5,017,000
Total	....	$3,753,562	$1,677,169,000

The tabulation of group 3 is as follows:

Companies	Value of farms per acre	Total losses of each company, 1910–1922	Total insurance in each company, 1910–1922
Cayuga County	$73	$153,536	$ 90,442,000
Farmers of Cayuga	73	93,697	53,433,000
Dwelling House of Cayuga	73	2,704	5,160,000
Cayuga Patrons	73	132,725	73,989,000
Chautauqua Patrons	77	346,397	174,795,000
Madison-Onondaga	78	138,062	66,902,000
Cooperative of Wyoming and Genesee	81	45,081	22,942,000
Patrons of Seneca	87	146,015	61,633,000
Ontario Patrons	95	169,956	72,301,000
Ontario	95	132,422	44,493,000
Onondaga Patrons	97	67,115	34,175,000
Genesee Patrons	97	176,802	85,811,000
Patrons of Onondaga and Oswego	97	16,351	6,390,000
Total	....	$1,620,863	$792,466,000

Group 3 includes 13 county companies whose land values range from $73 to $102 per acre.

The ratio of losses to insurance of companies in this group equals $1,620,863 divided by 792,466, or $2.05 per $1000 insurance.

Counties included in group 3 are Cayuga, Chautauqua, Genesee, Ontario, Livingston, Onondaga, and Yates.

The tabulation of group 4 is as follows:

Companies	Value of farms per acre	Total losses of each company, 1910–1922	Total insurance in each company, 1910–1922
Erie County	$110	$135,768	$57,813,000
Fire Relief of Wayne	117	276,022	139,211,000
Orleans	121	246,330	140,355,000
Niagara and Erie	126	81,461	41,827,000
Erie and Niagara	126	493,709	236,923,000
Farmers Mutual of Orleans and Niagara	132	357,645	178,076,000
German-American of Niagara	142	79,322	41,889,000
Monroe Patrons	165	228,158	127,156,000
Total	.....	$1,898,415	$963,250,000

Group 4 includes 8 county companies whose land values are over $102 per acre.[19]

The ratio of losses to insurance of companies in this group equals $1,898,415 divided by 963,250, or $1.97 per $1000 insurance.

Counties included in group 4 are Erie, Niagara, Orleans, Monroe, and Wayne.

[19] Agricultural counties whose land values are relatively high because of their proximity to New York City were not included in this classification. These counties are Suffolk, Westchester, Orange, Dutchess, Ulster, and Nassau.

APPENDIX H

AVERAGE LOSSES PER $1000 INSURANCE IN COUNTY COOPERATIVE ASSESSMENT INSURANCE COMPANIES

(1)

The average losses per $1000 insurance in county assessment companies other than grange, from 1910 to 1922, are shown in the following table:

Name of company	Total losses of each company, 1910–1922	Total insurance in each company, 1910–1922	Losses per $1000 insurance
Farmers of Steuben	$141,796	$41,538,000	$3.41
Otsego	153,789	67,543,000	2.28
Fidelity	184,982	55,110,000	3.36
Allegany	233,567	78,232,000	2.99
Saratoga	52,337	18,272,000	2.86
Farmers Mutual of Catskill	20,117	9,076,000	2.22
Mutual of Nassau	54,425	14,752,000	3.69
Fulton and Montgomery	273,617	91,773,000	2.98
Rensselaer	291,158	119,997,000	2.43
Farmers Reliance of Chemung	507,607	169,310,000	2.78
Broome	67,320	33,869,000	1.99
Cattaraugus	292,464	93,475,000	3.13
St. Lawrence	442,421	167,421,000	2.64
Schoharie and Schenectady	203,227	102,241,000	1.99
Farmers of Greenville	43,369	27,584,000	1.57
Cherry Valley	32,758	20,371,000	1.61
Fire Relief of Oswego	242,634	94,382,000	2.57
Farmers of Minden	22,196	19,239,000	1.15
Mohawk Valley	3,838	3,124,000	1.23
Callicoon of Sullivan	154,383	55,681,000	2.77
Westmoreland	61,629	42,172,000	1.46
Farmers of Oneida	159,172	76,591,000	2.08
Sauquoit	116,162	53,712,000	2.16
Cayuga County	153,536	90,442,000	1.70
Farmers of Cayuga	93,697	53,433,000	1.75
Dwelling House of Cayuga	2,704	5,160,000	0.52
Madison, Onondaga	138,062	66,902,000	2.06
Wyoming and Genesee	45,081	22,942,000	1.96
Ontario	132,422	44,493,000	2.98
Erie County	135,768	57,813,000	2.35
Fire Relief of Wayne	276,022	139,211,000	1.98
Orleans	246,330	140,355,000	1.76
Niagara and Erie	81,461	41,827,000	1.95
Erie and Niagara	493,709	236,923,000	2.08
Farmers Mutual of Orleans and Niagara	357,645	178,076,000	2.01
German American of Niagara	79,322	41,889,000	1.89
Cooperative of Sullivan	107,836	18,196,000	5.93
Farmers of Red Hook	13,483	4,534,000	2.97
Suffolk and Nassau	6,916	1,777,000	3.80
Total	$6,118,962	$2,599,438,000	....
Weighted average	....	....	$2.35

The ratio of losses to insurance equals $6,118,962 divided by 2,599,438, or $2.35 per $1000 insurance.

(2)

The losses per $1000 insurance in county grange companies are shown in the following table:

Name of company	Total losses of each company, 1910–1922	Total insurance in each company, 1910–1922	Losses per $1000 insurance
Delaware	$ 65,362	$ 21,444,000	$3.05
Chenango	217,628	102,240,000	2.13
Tioga	179,745	64,967,000	2.78
Steuben	206,606	78,341,000	2.64
Otsego	37,992	16,070,000	2.36
Montgomery and Fulton	37,568	17,277,000	2.17
Clinton	181,700	64,450,000	2.78
Broome	31,991	18,133,000	1.76
Tompkins and Schuyler	95,424	57,601,000	1.66
Cortland Patrons	108,719	48,382,000	2.25
Patrons of Cortland	24,868	12,034,000	2.07
Cattaraugus	90,806	29,747,000	3.05
St. Lawrence	396,314	170,571,000	2.32
Herkimer	109,425	60,907,000	1.80
Jefferson	312,934	233,291,000	1.34
Oneida Grange	5,615	4,752,000	1.18
Madison	27,524	12,112,000	2.27
Wyoming	19,062	5,017,000	3.80
Cayuga	132,725	73,989,000	1.79
Chautauqua	346,397	174,795,000	1.98
Seneca	146,015	61,633,000	2.37
Ontario	169,956	72,301,000	2.35
Onondaga	67,115	34,175,000	1.97
Genesee	176,802	85,811,000	2.06
Onondaga and Oswego	17,408	7,120,000	2.44
Monroe	228,158	127,156,000	1.79
Dutchess and Columbia	244,136	91,067,000	2.68
Westchester and Putnam	13,260	6,185,000	2.14
Ulster	104,881	44,638,000	2.35
Total	$3,796,136	$1,796,146,000	....
Weighted average	....	....	$2.11

The ratio of losses to insurance equals $3,796,136 divided by 1,796,146, or $2.11 per $1000 insurance.

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Results of Sweet-Corn Suckering Experiments

H. C. Thompson

GOLDEN BANTAM SWEET CORN, NOT SUCKERED
On left, main stalks; on right, suckers

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RESULTS OF SWEET-CORN SUCKERING EXPERIMENTS

H. C. Thompson

In the early days of sweet-corn production the practice of removing the suckers, or tillers, which grow around the base of the plants, was a very common one. The practice is still followed by growers of sweet corn, both for market and for canning, in many sections of New York State as well as in other States. It has, however, been discontinued by many growers because they have felt that the expense involved was not justified. Considerable difference of opinion exists as to the effect of removing the suckers on the yield and the value of the crop. Those favoring the practice claim that removing the suckers results in (1) a larger total yield of corn; (2) a larger yield of high-grade ears; (3) earlier maturity, therefore increased returns; (4) larger ears; (5) more even maturity; (6) a better-colored husk; and (7) less work in harvesting.

It is claimed that the suckers interfere with the harvesting operation, for they tend to reduce the open space between the rows. This makes it more difficult for the worker to get through the field and adds to his discomfort when harvesting while the foliage is wet.

Growers and others who question the value of removing the suckers call attention to the fact that there is no experimental evidence to justify the claims made. There must be some definite advantage to justify a practice which requires labor and expense.

PREVIOUS WORK

Very little experimental work on sweet-corn suckering has been undertaken and what has been done was not carried on with enough repetitions nor for a sufficient number of years to justify drawing any definite conclusions from the results. DeBaun (1916) reported results of three cooperative tests conducted in Bergen County, New Jersey, in 1915 in which ten rows of ten hills each were selected for the test and the treatments were in duplicate. The name of the variety was not given. The treatments and the average yields of dry ear corn per row were: (1) check, not suckered, 17.08 pounds; (2) suckered when plants were one foot high, 14.17 pounds; (3) same as (2) with second suckering later, 13.46 pounds; (4) suckered when plants were two feet high, 13.75 pounds; and (5) suckered when tassels began to show, 12.37 pounds.

DeBaun, commenting on these tests, says:

> During favorable growing seasons the yield of sweet corn is reduced in proportion to the lateness of suckering. Corn not suckered gives the heaviest yield. Sweet corn suckered early in its growth will be ready for market two to four days earlier than that suckered late or not at all.
>
> It is quite possible that somewhat different results might be secured during a dry growing season.

Hepler (1922) gave the results of an experiment at the New Hampshire station with two varieties, Early Crosby and Golden Bantam. Four rows 250 feet long were planted to each variety. Two rows were suckered and

two were left as check. With Early Crosby, the unsuckered rows produced 5.8 per cent larger yield than did the suckered rows, but the ears from the suckered rows averaged one-third of an ounce heavier than those from the check rows. With Golden Bantam there was a 2.6-per-cent increase in yield from suckering, but practically no difference in size of ears between the two treatments.

The Nassau County, New York, Farm Bureau made five cooperative tests in 1922, and four of these gave results, in yields and net returns, in favor of removing the suckers. The fifth test gave results adverse to suckering in both yield and net returns. The Long Island Beauty was used in four of these tests and Kroemer's Special White was grown in the fifth. The growing season was exceptionally moist. These tests were conducted for one year only and the treatments were in duplicate only; therefore the results are not clearly significant.

Montgomery (1916) summarized the results obtained with field corn in experiments at the Nebraska station covering a period of five years. In every case the yield was reduced by removing the suckers (tillers). Montgomery states that the occasions are very rare when it would pay to remove the tillers.

Lyon (1905:23) reported two-years results of removing suckers from field corn in Nebraska which showed a marked decrease in yield due to suckering. The average yield of grain per acre was 64 bushels for the suckered plats and 81 bushels for the unsuckered plats.

Ricks (1915) gave the results of experiments carried on with field corn for two years in Mississippi. Corn suckered when four feet high averaged 34 bushels per acre, and when six feet high 33.7 bushels; the unsuckered corn averaged 39.15 bushels per acre.

EXPERIMENTS AT CORNELL UNIVERSITY

Object and outline

The main object of the experiments was to determine the effects of removing suckers on (1) the total yield of marketable ears, (2) the yield of Grade 1 ears, (3) earliness, and (4) size of ears.

The area selected for the experiment was divided into two blocks so that a two-years rotation could be followed. The soil is a loam of moderate fertility. With the exception of the first year, the land was plowed in the fall and planted to rye. Fresh manure at the rate of about 15 tons per acre was applied each year except 1920. The manure was plowed under about two weeks before the corn was planted. Fertilizer applications consisted of 800 pounds per acre of approximately a 2-8-4 mixture in 1920 and 1921, and a 4-8-4 mixture in the other years. The mixture was made up of nitrate of soda, tankage, acid phosphate, and muriate of potash. Applications were made broadcast in the spring after the land was plowed, and the material was thoroughly mixed with the surface soil by harrowing.

Two varieties, Golden Bantam, which suckers or tillers rather freely, and Stowell's Evergreen, which produces relatively few suckers, were used in the experiment. The seed was planted in hills with a hand planter, dropping five or six kernels in each hill. Golden Bantam was planted 2 by 3 feet, and Stowell's Evergreen 3 by 3 feet. After the plants were well

FIGURE 1. UNSUCKERED AND SUCKERED HILLS OF GOLDEN BANTAM SWEET CORN
On left, unsuckered (check); in center, suckered early; on right, suckered early and suckering continued as new suckers developed

established, they were thinned to three to each hill. Thirty rows, 150 feet long, were planted to each variety, one row on each side being used as a guard row, and at least one hill on each end of every row was discarded. Four treatments were given as follows:

A. Check — suckers allowed to grow.
B. Suckers removed when the plants were from 12 to 18 inches high. Any suckers that developed after this were allowed to remain.
C. Suckers removed same as in B and others pulled off as they appeared during the season.
D. Suckers removed when the plants began to tassel.

There were six replications, or seven rows, in each treatment. These were arranged in a continuous series. Rows 1, 5, 9, 13, 17, 21, and 25 were given check treatment A; rows 2, 6, 10, 14, 18, 22, and 26, treatment B; rows 3, 7, 11, 15, 19, 23, and 27, treatment C; and rows 4, 8, 12, 16, 20, 24, and 28, treatment D. Treatment A in any series was 3 feet from B,

6 feet from C, and 9 feet from D, but A in any one series was only 3 feet from D in the preceding series. It would seem that this plan would tend to overcome any differences due to soil heterogeneity.

Suckers were removed by hand at the proper time for each treatment and care was taken to have the work done in a uniform manner. In harvesting and grading, care was also taken to have the work done uniformly. One man did all of the harvesting every year and the grading was likewise done by one person (the writer). The ears ready for market at each harvest period were pulled off and carried to the field house, where they were graded into two grades, 1 and 2. Grade 1 consisted of ears of good marketable size and well filled. Grade 2 consisted of the ears which did not meet the standard for Grade 1, but which were marketable. Small ears or those poorly filled were discarded and no record was kept of them after the second year. Ordinarily, the ears below the market grades should be left on the stalk.

Results

Effect of removing suckers on yield

At each picking the ears from each row were graded into the two market grades. Records were kept of the number and weight of ears of each grade and the data for Grades 1 and 2 were added to obtain the yield of marketable ears. The yield of marketable ears for each year, and the five-year average for both varieties of corn used in the experiment, are given in table 1. The odds shown in the last column of this table, and in the subsequent tables, were calculated by "Student's" method, using Love's (1924) modification of "Student's" table.

The large variations in yield from year to year probably are due mainly to difference in rainfall. In 1923 the rainfall was 2.03 inches in June, 2.89 inches in July, and 0.54 inch in August, as compared to a normal rainfall for these three months of 3.88, 3.75, and 3.24 inches, respectively. This light rainfall for these three months in 1923 had a marked effect on the yield of Stowell's Evergreen corn.

The data for the five-year average show a reduced yield from removing the suckers, treatment D showing the greatest reduction. In three years out of five the unsuckered rows of Golden Bantam produced a higher yield than did any of the others; in one year, treatment B gave the highest yield; and in one year, treatment C. In two years, treatment B outyielded treatment C, while in the other three years the opposite was true. Treatment D produced the lowest yield every year. With Stowell's Evergreen, treatment A produced the highest yield two years out of five, exactly the same yield as treatment C one year, a lower yield than C in the other two years, and a higher yield than B every year. Treatment D produced the lowest yield in four years out of five and lower than treatment A every year.

The odds given in the last column indicate that the differences in yield between treatment A and the others are not significant with the Golden Bantam variety. That is, the odds are less than 30:1. There is general agreement among statistical workers that where the odds are less than 30:1, it is not safe to assume that the differences are due to the treatment alone.

TABLE 1. TOTAL YIELD OF MARKETABLE EARS OF SWEET CORN IN SUCKERING EXPERIMENT

(By years and the five-year average. Weights are given in pounds)

Treatment	1920		1921		1922		1923		1925		Five-year average		Odds*
	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	
							Golden Bantam						
A..........	1,222	369 6	1,379	538 5	916	337 0	982	380 5	932	378.8	1,086	400.9	
B..........	1,121	328 0	1,317	518 2	897	333.2	999	403 7	875	356 6	1,042	387 9	6:1
C..........	1,039	314.2	1,333	533.3	924	342.2	935	376 7	891	373 2	1,024	387.9	8:1
D..........	953	219 8	1,251	496 0	878	331.7	914	363.7	757	312.1	951	344 7	18:1
							Stowell's Evergreen						
A..........	583	420.5	925	715.0	869	601 0	432	270 5	651	533 5	692	508 1	
B..........	526	387 5	929	712.2	819	563.5	432	269 7	654	511.7	672	488 9	29:1
C..........	532	389.5	904	715.0	805	561 0	477	293 7	662	536.5	676	499 1	3:1
D..........	556	398 7	902	687.5	802	555.0	376	248 5	614	491.0	650	476 1	399:1

*Odds based on comparison with check (unsuckered) rows (A).

FIGURE 2. GOLDEN BANTAM SWEET CORN SUCKERED WHEN TWELVE TO EIGHTEEN INCHES HIGH

Stalks at left, second crop of suckers at right

With the Stowell's Evergreen, the differences in yield between treatments A and B and A and C are not clearly significant since the odds are less than 30:1. The difference in yield between treatments A and D is significant and shows that removing the suckers when the plants were beginning to tassel resulted in reduced yield. The odds are 399:1. This means that the odds are 399:1 against a difference as great as this being due to chance alone.

The fact that most of the differences in yield between the unsuckered and the suckered rows are not statistically significant should not be taken to mean that definite conclusions cannot be drawn from the experimental results. All of the suckering treatments resulted in a decrease in yield as compared with the check, although the differences are not significant except

between the check and treatment D. Since suckering increased the cost of production, it is apparent that the practice resulted in loss, as far as total yield is concerned.

Effect of removing suckers on yield of Grade 1 ears

All of the ears put in Grade 1 were of good marketable size for the variety, were well filled, and otherwise met the requirements for a high-grade product. It has been thought by many growers that suckering reduces the quantity of the best grade of corn, even though the total yield is not reduced. In these experiments this was not the case, as is shown by the yield records given in table 2.

Examination of table 2 shows variations in yield of Grade 1 ears between the different treatments. A comparison of the yield of Grade 1 ears of treatment A with the yield of the same grade of the other treatments shows a small and inconsistent difference except with treatment D of Stowell's Evergreen. Here the disadvantage of late suckering, when the suckers are large, is evident, as in the case of the total marketable yield. The evidence does not indicate any advantage of removing the suckers as far as the yield of Grade 1 ears is concerned, but does indicate a clear disadvantage where they were removed after they had reached a large size. The odds are 94:1 against a difference as large as this being due to chance alone. With Golden Bantam the odds are too small for the differences to be considered of any definite significance.

Effect of removing suckers on earliness

As already suggested, one of the advantages claimed for suckering is earlier maturity. In order to get information on this subject, the first picking was made as soon as enough ears had reached the edible stage to make it worth while. The number and weight of ears harvested at the first picking was taken as the measure of earliness. In some seasons the corn changed quickly from the pre-milk to the best edible stage, while in other seasons this change took place more slowly. In general, the higher the temperature, the more rapid is the change, as has been shown by Appleman (1923). This fact accounts, in a large measure, for the low yields at the first harvest some years and the relatively large yields in other years. The number and weight of ears harvested at the first picking each year and the average for the five years are given in table 3.

While there are small differences between the four treatments in the yield of marketable ears at the first picking, these are not consistent and the odds indicate that they are not significant for either Golden Bantam or Stowell's Evergreen. The advantage in earliness of maturity claimed for removing the suckers is not borne out by the data here presented, in spite of the slight increase in yield of ears in treatments B and C over treatment A as shown in the five-year average. Under some conditions removing the suckers might make for early maturity, while under others it might have the opposite effect.

TABLE 2. TOTAL YIELD OF GRADE 1 EARS OF SWEET CORN

(By years and the five-year average. Weights are given in pounds)

Treatment	1920		1921		1922		1923		1925		Five-year average		Odds*
	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	
						Golden Bantam							
A..........	881	302.5	1,019	434.3	611	249.0	746	311.5	758	333.7	803	326.2	
B..........	788	266.2	1,018	429.7	616	252.0	805	311.5	688	308.6	783	313.6	11:1
C..........	737	254.6	1,043	445.7	632	256.0	750	318.7	742	335.7	781	322.1	1:1
D..........	724	247.5	972	411.0	629	253.0	734	309.2	633	278.2	738	299.8	18:1
						Stowell's Evergreen							
A..........	419	340.5	778	634.5	624	491.7	212	151.5	459	442.7	498	412.2	
B..........	395	325.2	791	636.5	568	447.5	184	134.5	473	430.7	482	394.9	23:1
C..........	410	328.7	791	641.7	573	450.0	188	134.0	498	456.0	492	402.1	5:1
D..........	421	335.5	764	610.5	552	437.2	165	116.5	447	410.2	470	382.0	94:1

* Odds based on comparison with check (unsuckered) rows (A).

TABLE 3. TOTAL YIELD OF MARKETABLE EARS OF SWEET CORN, FIRST PICKING

(By years and the five-year average. Weights are given in pounds)

Treatment	1920		1921		1922		1923		1925		Five-year average		Odds*
	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	Number of ears	Weight	
						Golden Bantam							
A	586	203.0	195	82.5	260	104.0	119	48.0	354	152.8	303	118.1	11:1
B	566	193.7	239	100.2	310	121.7	159	68.5	347	154.4	324	127.7	3:1
C	500	177.0	255	108.7	358	135.7	126	51.0	358	158.7	319	126.2	3:1
D	510	179.7	198	83.2	294	123.0	91	36.7	320	143.8	283	113.3	
						Stowell's Evergreen							
A	201	168.7	194	157.7	620	473.0	281	183.0	156	154.7	290	227.4	3:1
B	201	168.0	248	206.0	573	440.0	303	190.5	192	181.7	303	237.2	6:1
C	220	179.2	287	238.5	583	442.0	323	195.5	220	208.7	327	252.8	Too small to calculate
D	218	176.0	227	187.0	567	428.7	239	168.0	193	182.5	289	228.4	

*Odds based on comparison with check (unsuckered) rows (A).

Effect of removing suckers on size of ears

The average weight of ears has been calculated for each year and for the five-year average for both varieties of corn used in the experiments. The results are given in table 4 for both total marketable and Grade 1 ears.

TABLE 4. AVERAGE WEIGHT, IN OUNCES, OF TOTAL MARKETABLE AND GRADE 1 EARS

Total marketable

Treatment	1920	1921	1922	1923	1925	Five-year average	Odds*
Golden Bantam							
A.	4 83	6 24	5.89	6.19	6.50	5 90	
B.	4 67	6 29	5 94	6 46	6 51	5.95	3:1
C.	4.83	6 40	5.92	6 49	6 70	6 06	49:1
D.	3 70	6 34	6 05	6.37	6 59	5.79	2:1
Stowell's Evergreen							
A.	11 54	12 37	11.06	10 02	13 10	11.74	
B	11 79	12.27	11.01	9 98	12.51	11.63	1:1
C.	11 71	12 66	11 15	9 86	12.96	11.81	3:1
D.	11.47	12 19	11 07	10 58	12.80	11.71	None

Grade 1

Treatment	1920	1921	1922	1923	1925	Five-year average	Odds*
Golden Bantam							
A.	5 49	6.82	6 53	6 69	7 04	6.50	
B.	5 41	6 75	6 54	6 19	7.18	6.42	3:1
C.	5 52	6 83	6.48	6 80	7.23	6.61	10:1
D.	5.47	6 77	6.43	6.74	7.02	6.50	6:1
Stowell's Evergreen							
A.	13 01	13 06	12 61	11 44	15.42	13.25	
B.	13.17	12 88	12.61	11.70	14.58	13.10	5:1
C.	12 83	12.98	12.56	11.41	14 66	13.07	10:1
D.	12 75	12 78	12.67	11.30	14.69	13.01	3:1

*Odds based on comparison with check (unsuckered) rows (A).

The data in table 4 show that the size of ears of any given treatment varied from year to year. A large part of this variation probably was due to difference in weather conditions, especially to difference in rainfall, but some might have been due to slight variations in grading. It was very evident in 1925 that the ears of Stowell's Evergreen were larger than usual. This undoubtedly was due to good moisture conditions. In 1923 the ears were small and the rainfall was very light during June, July, and August, being only about 50 per cent of normal.

The relative size of ears from the four treatments also varied from year to year, so that the differences indicated in the five-year average are not significant except in the case of the comparison between treatments A

and C of the total marketable yield of Golden Bantam. Here the odds are 49:1 against the difference being due to chance alone, but even in this case the average difference is less than one-sixth of an ounce. The greatest difference in average weight per ear between these two treatments (A and C) in any year was less than one-third of an ounce, which seems to the writer to be of little or no consequence. A comparison of average weight of Grade 1 ears from the different treatments shows variations similar to those in "Total marketable." In Golden Bantam, the average weight (five-year average) was highest from treatment C, while with Stowell's Evergreen it was highest from treatment A. The odds indicate that the difference between A and the others is not significant with either variety. From these data, one could not recommend suckering for the purpose of increasing the size of ears.

Effect of removing suckers on yield of stover

Since sweet-corn stover is a valuable by-product, it seemed desirable to determine the reduction in yield of this material due to removing the suckers. In 1922 and 1923 the stover was cut and weighed after the last picking of ears. The yields, computed in pounds per acre, are given in table 5:

TABLE 5. AVERAGE YIELD OF STOVER, IN POUNDS PER ACRE, UNDER THE FOUR TREATMENTS

Treatment	Golden Bantam	Stowell's Evergreen
A	9,525	10,873
B	7,385	9,455
C	6,960	10,000
D	6,502	9,211

The results show that removing the suckers reduced the yield of stover with both varieties, but that the reduction was greater with Golden Bantam than with Stowell's Evergreen. This would be expected, since Golden Bantam suckers more freely than does Stowell's Evergreen. One suckering early in the season reduced the yield of stover more than one ton per acre in the Golden Bantam variety. Continued removal of suckers still further reduced the yield of stover of this variety. The greater yield of stover in treatment C over treatment B with Stowell's Evergreen is not explained but might have been due to mere chance. In 1922 the two treatments produced the same yield. Removing the suckers when the main stalks were in tassels (D) reduced the yield of stover more than any other treatment, just as this treatment resulted in the greatest reduction in yield of marketable ears.

Cost of removing suckers

In 1923 records were kept of the time spent in removing the suckers in the different treatments. Seven rows of treatment B required 45 minutes, and, since the area was practically one-fourteenth of an acre, the time to remove the suckers from an acre would have taken ten and one-half hours. At 40 cents an hour, the cost would have been $4.20. With treatment C, where the suckers were removed three times, the time taken was one and

one-half hours, or twice as long as with treatment B, and at a cost of $8.40 per acre. Suckering the rows in treatment D required approximately the same time as in treatment B. It required slightly less time to remove the suckers from Stowell's Evergreen.

While it probably took more time to do the work under experimental conditions than would be the case under commercial culture, the cost of suckering once would cost at least $3 per acre in ordinary practice. The cost of suckering twice would be at least $4.50, and three times, $6 or more, per acre. Three growers in Nassau County, who conducted tests in cooperation with the Farm Bureau in 1922, estimated the cost of suckering at $2.80, $2.96, and $6 per acre, respectively.

Summary

The data presented in this bulletin show that, in these experiments, removing suckers from Golden Bantam and Stowell's Evergreen sweet corn did not result in the advantages sometimes claimed for the practice. The total yield of marketable ears was greatest on the unsuckered rows although the difference is not clearly significant except between the unsuckered and the late-suckered rows of Stowell's Evergreen, where the odds were 399:1. This indicates that late suckering was injurious. The statement, often made, that the removal of suckers allows the nutrients (often spoken of as plant food) to go to the ears is based on an erroneous assumption. The raw materials taken into the plant do not go direct to the ear but must be built up into complex compounds in the leaves and other green parts of the plant before they can be utilized in seed formation or in other growth. Reduction in foliage results in the upsetting of the balance of the plant and in decreasing the food-manufacturing area. Under some conditions reducing the foliage might be advantageous, but under others it is decidedly disadvantageous. The difficulty is that one cannot predict in advance what the effect will be.

It is also obvious from the data that there is no consistent advantage in earliness due to removal of the suckers. In some years there appeared to be a slight advantage, but in other years this was not the case. In no comparison are the odds large enough to justify the conclusion that the differences are due to treatment alone. Even if the small differences indicated in the five-year average were due to treatment alone, we could not justify the practice, especially in growing sweet corn for canning.

The claim, sometimes made, that removing the suckers results in the production of a larger quantity of large ears is not borne out in these experiments. In fact, the reverse was true, although the differences are not clearly significant except between the unsuckered and the late-suckered Stowell's Evergreen. The late suckering (D) reduced the yield about 5 per cent, as compared to the check, with odds 94:1 that the difference was not due to chance alone. Ordinarily, a 5-per-cent difference would not justify a change in practice if this change resulted in greater expense, but in this particular case it would result in a decrease in expense of from $3 to $6 per acre.

In size of ears these experiments do not show any significant differences between the treatments. The five-year average for total marketable ears (table 4) shows a slight gain for treatments B and C and a loss for treatment D with the Golden Bantam, while with the Stowell's Evergreen

there is a slight gain for treatment C and a loss for treatments B and D as compared with A. None of these differences are significant except between A and C of Golden Bantam, where the odds are 49:1, but even there the average difference is less than one-sixth of an ounce. In the case of Grade 1, there is a gain for C in the five-year average for Golden Bantam and a loss for B and D; with Stowell's Evergreen there is a loss for the three suckering treatments. The odds show that these differences are not significant.

Removing the suckers decreased the yield of stover, the late suckering resulting in the lowest yield. The difference of a ton or more of stover to the acre is worth considering, since this is a valuable roughage, being higher in feeding value than field-corn stover.

Since removing the suckers costs from $3 to $6 an acre, and, in these experiments, resulted in a reduction in yield of both corn and stover, without any clearly apparent gains in earliness, size of ears, or other important advantage, growers should seriously question the value of the practice.

Of course it is possible that under other conditions the results might be different. For example, on a very rich soil in a wet season, there might be an excessive growth of foliage and a poor or delayed development of ears. Under such conditions reduction of the foliage by removing the suckers might be of some advantage, but at the time of suckering we have no way of knowing what the weather conditions are going to be during the time ears are forming. It should be borne in mind, however, that a good yield of ears cannot be produced without a good growth of foliage.

The only sure way by which any farmer can determine the effects of removing suckers on yield of corn on his farm is to make tests under his own conditions. To make these tests reliable, each treatment must be replicated several times and carried on for at least three years. Results obtained from one unreplicated test, carried on for one year only, might be entirely misleading.

The writer is of the opinion that under most conditions the practice of suckering is not justified and is more likely to result in loss than in gain. The later the suckering, the greater is the chance for loss.

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The Relative Efficiency of Some Copper Dusts and Sprays in the Control of Potato Diseases and Insect Pests

Oran Cecil Boyd

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THE RELATIVE EFFICIENCY OF SOME COPPER DUSTS AND SPRAYS IN THE CONTROL OF POTATO DISEASES AND INSECT PESTS[1]

ORAN CECIL BOYD

Dusting for the control of plant diseases has received almost constant consideration by the Department of Plant Pathology at Cornell University since the revival of the practice of sulfur dusting in 1910 (Blodgett, 1913, 1914).[2] Since 1912, orchard dusting with sulfur-arsenate mixtures in several sections of the country, including New York, has in part replaced the sulfur sprays. As a result of the work of Sanders and Kelsall (1918), a new interest was created in the use of a copper dust which differed from the various brands of bordeaux powders by containing its copper in the form of dehydrated copper sulfate.

In 1919 and particularly in 1920, the Department, through its fellowships, extended the dusting investigations to include vegetables and truck crops, employing the dry copper preparations mentioned above in comparison with standard bordeaux mixture. During these years promising results were obtained, especially on potatoes and celery. In 1921, on the strength of these preliminary trials, a special investigation[3] in the dusting and spraying of potatoes was begun, the results of which are recorded herein.

The purpose of the investigation was to compare certain dusts and spray mixtures, particularly copper-lime dust with bordeaux mixture, in the control of potato diseases and insect pests. Emphasis was placed upon late-blight and flea-beetle control. Regarding the problems for consideration, special weight was given to such phases as the relative adhesiveness of the fungicides and their effectiveness in control, the cost of application, and the types of dusting and spraying machinery. Attention was given also to other factors which appeared to influence the effectiveness of the fungicides under trial. The character of the experiments was adjusted to the particular problems in the sections concerned. The greater part of the experimental work was conducted in Suffolk County, Long Island. In 1921, additional experiments were performed in Washington County.

NATURE OF COPPER-LIME DUST

The material known as "Sanders' dust," or copper-lime dust, consists of a mixture of partly dehydrated copper sulfate, and hydrated lime. Mixtures that contain no arsenates are generally referred to as 15–85 dust, 20–80 dust, and so on, depending on the ratio of monohydrated copper sulfate to hydrated lime. If the dust includes a poison, the poison is usually supplied in the form of calcium arsenate. Such a mixture, for

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[2] Dates in parenthesis refer to *Bibliography*, page 65.

[3] The investigation was conducted under the provisions of the Herman Frasch Fellowships.

example, is the 15–8–73 dust, in which eight pounds of lime of the 15–85 formula has been replaced by an equal weight of calcium arsenate. On the other hand, similar dusts have been referred to by Sanders and Kelsall (1918, 1920) as 5–2 and 9–5 dusts, the numbers representing the percentages of metallic copper and arsenic, respectively.

The precipitate that is formed when copper-lime dust is applied to damp foliage resembles, to a marked extent, the covering produced by a bordeaux mixture rich in lime. If the dust is applied to a wet surface, or to a dry surface to which water is added subsequently, the copper salt undergoes hydration, passes into solution, and combines with the lime to form a blue bordeaux mixture. Such a dust may be said to represent an "incomplete" bordeaux mixture, requiring only the contact with water to complete the preparation.

PRECIPITATION MEMBRANES

The physical nature of the precipitate in bordeaux mixture, as indicated by the investigations of Lutman (1916), Butler (1914), Butler and Smith (1919), Cook (1920), Gastine (1906), and others, determines, to a large extent, the efficiency of the preparation as a fungicide. The important property, adhesiveness, depends primarily upon the physical nature of the precipitation membranes. When bordeaux mixture is sprayed on foliage, the colloidal membranes in suspension slowly settle, partially coalesce as water evaporates from the wash, and finally form a thin gelatinous layer, which, on completely drying, becomes firmly attached to the surface of the leaf.

No references in literature were found pertaining to the physical properties of the precipitate formed by the copper-lime dust. It was considered worth while, therefore, to make microscopical examinations of the dust layer, noting the size, the shape, and the surface-covering power of the precipitated copper-containing particles as compared with the membranes in bordeaux mixtures. It might thus be possible to explain differences in the degree of adhesiveness of the two fungicides.

In studying the dust coating, the following procedure was observed. A series of glass plates of uniform size were dusted with a hand machine applying equal amounts, with uniform distribution, of the dust to be examined. No differences were noted in the character of the precipitates when slides sprayed with water previous to being dusted were compared with slides dusted while dry and given moisture later. After the slides were exposed in the open for two days or longer, they were divided into two series. One series was tested for the amount of copper per unit area, the other was reserved for an examination of the precipitate.

In the study of the precipitation membranes of bordeaux mixtures, the procedure was essentially the same as the method employed by Lutman (1912 b). A standard bordeaux mixture was prepared from copper sulfate and freshly prepared hydrated lime.[4] From this stock solution, dilutions of varying degrees were made. The mixture obtained from a 4–4–50 bordeaux preparation by making three successive dilutions is represented by the formula $\frac{1}{2}$–$\frac{1}{2}$–50, and contains one-eighth as much copper per unit

[4] In all of the formulae given in this paper which refer to bordeaux mixtures, the number representing the proportion of lime, unless otherwise designated, refers to calcium hydroxide.

volume as does the original stock solution. Before known amounts of the dilutions were removed for membrane study, the mixtures were sprayed from a hand sprayer into flasks, for the purpose of converting the suspension into a fine mist. The colloidal membranes were thus broken, and, when studied microscopically, might be said to represent the form and distribution that would be obtained when the mixture is sprayed on plants. Two-tenths of a cubic centimeter of the sprayed dilution was then pipetted upon a clean glass plate, the surface of which had been moistened with an extremely thin film of a dilute aqueous solution of gum arabic. This film permitted the bordeaux solution to spread out rapidly into a large, thin, circular drop. After the mixture had dried and the slide had been exposed to the air for forty-eight hours, the precipitate was stained with a dilute solution of potassium ferrocyanide in acetic acid. The same stain was employed for the dust precipitate.

The relative size, shape, and distribution of the dust and spray membranes were determined by tracing the outlines with the aid of a camera lucida. To estimate the percentage of surface covered by the copper membranes, the outlines were cut out, the paper was weighed, and its weight was compared with the weight of the original sheet representing the field. When mixtures more concentrated than a $\frac{1}{2}$–$\frac{1}{2}$–50 bordeaux were spread on the slide, the precipitate that remained after drying was in the form of a more or less continuous layer. Or, if a reasonably heavy application of dust was made, no well-defined individuality of membranes could be detected. For this reason, sufficiently high dilutions of sprays and light applications of dusts were made to permit a comparison of the two kinds of membranes.

The dust membranes (figure 1) stain red with the acid-potassium-ferrocyanide stain, are colloidal in nature, and, before drying to the surface, are more or less entire and usually spherical. They possess a rather thick wall and a relatively high specific gravity. The spray membranes, on the other hand, in a dilution as high as $\frac{1}{4}$–$\frac{1}{4}$–50, are small, exceedingly irregular in outline, and very thin as compared with the dust membranes (figure 2). They represent minute, ruptured fragments of larger, smoother membranes characteristic of the lower dilutions (figure 3). The dust membranes, after they have dried to the sur-

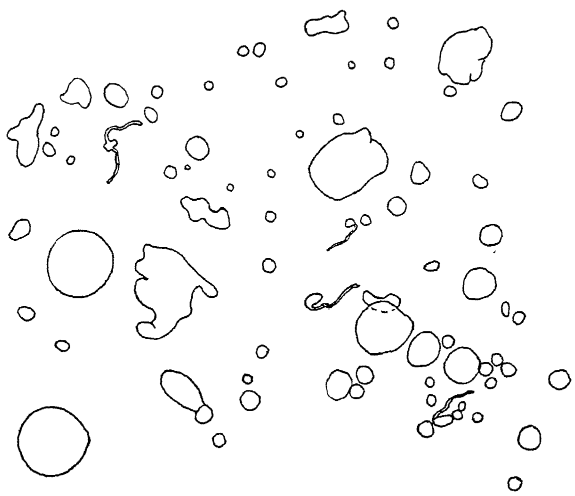


FIGURE 1. MEMBRANES OF A COPPER-LIME DUST APPLIED TO A WET SLIDE AND ALLOWED TO DRY; REPRESENTING 0.323 MILLIGRAM OF COPPER PER SQUARE DECIMETER. × 30

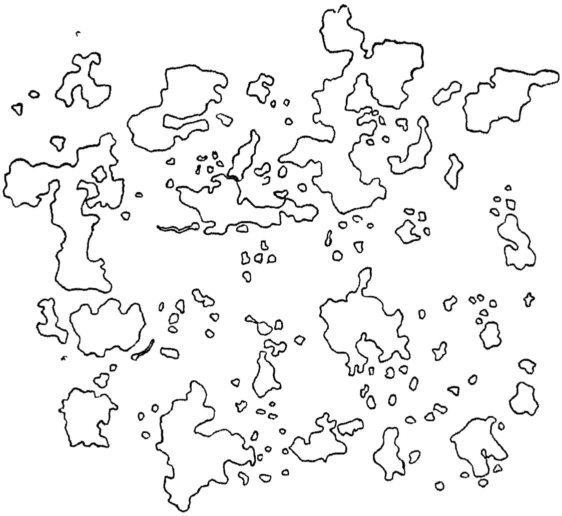


FIGURE 2. BORDEAUX MEMBRANES OF A 4–4–50 CONCENTRATION DILUTED TO ¼–¼–50, PIPETTED ON A GLASS SLIDE, AND ALLOWED TO DRY; REPRESENTING 0.34 MILLIGRAM OF COPPER PER SQUARE DECIMETER. × 30

face, resemble closely in texture, thickness, and other characteristics, the membranes in bordeaux mixtures varying in strength from ½–½–50 to 1–1–50, but usually remain circular in outline, flattened, and entire (figure 1).

The stained membranes of a ⅛–⅛–50 bordeaux mixture (figure 4) were so thin that the outlines could be followed only with difficulty in making the camera-lucida drawings. The membranes of the 1/16–1/16–50 mixture were too small to follow, in tracing outlines on paper with the use of a 16-millimeter objective and a 15-× ocular, and they were entirely too thin and hyaline to be observed with any degree of definition with the use of an 8-millimeter objective and an 8-× ocular.

The results of the study of the size and distribution of the spray and dust membranes are given in table 1. It may be noted, by comparing the first two columns of figures, that as the bordeaux mixture was diluted by adding, each time, a volume of water equal to that of the original volume, the number of milligrams of copper per square decimeter was reduced by more

TABLE 1. RESULTS OF COPPER TESTS SHOWING THE RELATIVE COVERING POWER OF COPPER-LIME DUST AND BORDEAUX MIXTURE ON GLASS PLATES

Fungicide	Milligrams of copper per square decimeter	Number of membranes per square millimeter	Per cent of surface covered in trial						Relative covering value per milligram of copper
			1	2	3	4	5	Average	
Dust (10-per-cent copper)........	0.323	11.20	23.3	20.4	24.3	25.4	....	23.35	72.30
Spray (½–½–50)...	1.000	5.33	42.1	44.2	44.0	....	....	43.43	43.43
Spray (¼–¼–50)...	0.340	27.20	33.5	31.6	29.0	31.2	32.8	31.62	93.00
Spray (⅛–⅛–50)...	0.098	66.00	19.0	17.6	18.7	....	....	18.43	188.00

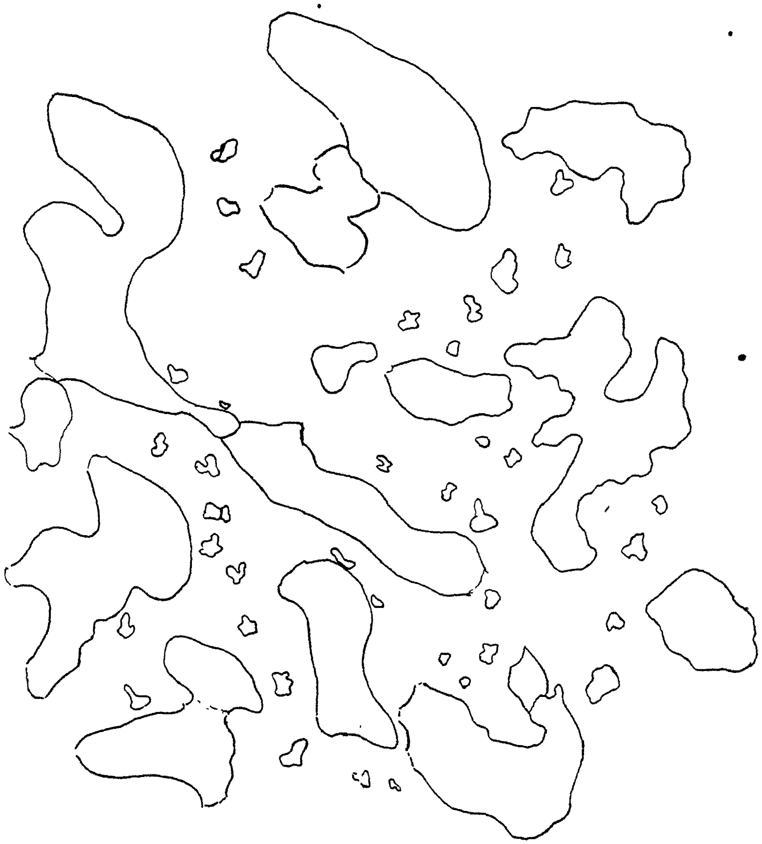


FIGURE 3. SAME AS FIGURE 2 EXCEPT FOR DILUTION, WHICH IS $\frac{1}{2}$–$\frac{1}{2}$–50, REPRESENTING 1 MILLIGRAM OF COPPER PER SQUARE DECIMETER. × 30

than one-half. This was due to the fact that the more dilute solutions tended to spread more and cover a larger area before the membranes settled to the surface of the slide. It is also apparent, in comparing the figures representing the number of milligrams of copper per square decimeter with the corresponding averages for the percentage of surface covered, that more surface per unit of copper present was covered at the lower concentrations. This increase in covering power is undoubtedly due to the fact that in the lower concentrations the membranes are broken into smaller and thinner membranes with less tendency to overlap.

The $\frac{1}{4}$–$\frac{1}{4}$–50 bordeaux mixture, which gave 0.34 milligram of copper per square decimeter, seems to be most nearly comparable with the dust, which gave 0.323 milligram of copper per square decimeter. Comparing these (figures 1 and 2), it is seen that there were more than twice as many membranes per unit area on the sprayed surface and that they covered a larger percentage of the area. This condition seems to result from the fact that the globular membranes which are formed in dusting a wet surface dry down entire, with double thickness, and are not broken up afterward

FIGURE 4. SAME AS FIGURE 2 EXCEPT FOR DILUTION, WHICH IS $\frac{1}{8}$–$\frac{1}{8}$–50, REPRESENTING 0.098 MILLIGRAM OF COPPER PER SQUARE DECIMETER. × 60

and scattered, as are the spray membranes. It therefore seems reasonable to suppose that a more even distribution of the copper precipitate is possible with the spray than with the dust.

ADHESION OF DUST AND SPRAY MIXTURES

In referring to the relative adhesiveness of dust and spray mixtures, Sanders and Kelsall (1920), in reporting the results of their potato dusting and spraying experiments in 1919, state that although approximately equal amounts of copper adhered to the leaves from the copper-lime dust and from the bordeaux mixture during the applications, subsequent copper tests showed that the spray possessed a higher degree of adhesiveness than did the dust. The authors recommended that, in order to obtain the maximum adhesiveness with the dust, one should dust when the foliage is thoroughly moist and the wind is low.

In the preliminary field experiments conducted by the writer in 1920, in which two copper dusts were used in comparison with spray mixtures,

foliage dusted in the early morning, when a heavy dew covered all parts of the tops, always showed a more prominent blue coating, after the fungicide had dried, than did plants that were dusted when little or no moisture was present. Such was the observation when either Sanders' dust or the dry bordeaux preparation known as "bordeaux-lead"[5] was used. Furthermore, the copper coating on the foliage sprayed with the lime-bordeaux mixture appeared to undergo less washing from rains than did that on dusted foliage, and the copper-lime dust seemed to possess a higher degree of adhesiveness than did the dry bordeaux preparation and to be about equal to soda-bordeaux in that respect. As no field tests for copper were made that year, no definite data were obtained regarding the adhesiveness of the fungicides in use.

Since adhesiveness is one of the important properties which determine the value of a fungicide, experiments were conducted to compare the adhesiveness of several fungicides.

THE COPPER TEST

For the determination of the amount of copper on foliage, a method was sought that would be adapted to both laboratory and field conditions. The general procedure followed was that outlined by Winston and Fulton (1919). The method, in brief, consists in immersing 200 grams of sprayed leaves in 1 liter of a 0.2-per-cent solution of nitric acid until the copper coating is dissolved. A few drops of a dilute solution of potassium ferrocyanide are then added to a portion of the wash and the color of the suspension is compared with that of a series of color standards previously prepared to represent varying concentrations of copper in terms of milligrams per 100 centimeters of solution. A few alterations in the method were found necessary for the sake of obtaining more nearly accurate results. The following include the principal changes in the procedure outlined by Winston and Fulton:

(1) The amount of acid wash for dissolving the copper was increased two- or three-fold.

(2) After washing the leaves, the solution was rendered alkaline with concentrated ammonium hydroxide, and reacidified to a point slightly acid to litmus. Unless this precaution is observed, the maximum copper reaction cannot be depended upon when potassium ferrocyanide is added. By observing it, extremely delicate tests can be made.

(3) Instead of using copper-sulfate crystals alone in making up the standard solutions for color comparisons, a bordeaux mixture was prepared from freshly slaked lime and a solution of copper sulfate which had previously been standardized for copper content. A certain volume of this mixture was poured into a wide-bottom glass vessel and allowed to dry and to undergo ordinary weathering in the open for two or three days. The precipitate was then treated exactly as the coating on the dusted or the sprayed leaves, that is, it was dissolved in the acid wash and the latter was brought to the proper degree of acidity. When dilutions for color standards are made from such a stock, the suspension which is formed when potassium ferrocyanide is added is more nearly comparable to that

[5] This proprietary mixture, furnished by Riches, Piver & Co., of New York City, represents an evaporated bordeaux mixture containing arsenate of lead. The powder contains 11½ per cent of metallic copper and 15 per cent of arsenate of lead. The directions provide for its use as either a dust or a spray.

obtained in the wash from the foliage than to the more or less permanent suspension that results from the addition of the same indicator to dilute solutions of pure copper sulfate. For the most accurate determinations, the indicator should not be added to the dilutions of the dissolved bordeaux stock solution, in preparing the color standards, until the day on which the comparisons are to be made.

(4) Instead of preparing a series of tubes or vials of known dilutions from the stock, and comparing the color of the unknown with those of the standards, only two or three dilutions were made, which represented relatively low copper contents, such as 2, 4, and 6 milligrams per 100 cubic centimeters, respectively.

The indicator was then added to all of the tubes, including a tube containing a definite volume of the foliage wash, and the wash was diluted gradually until the color matched that of one of the standards. The copper content of the original wash was determined by a simple calculation. The most accurate comparisons can be made only with rather dilute solutions, that is, solutions containing from 2 to 5 milligrams of copper per 100 cubic centimeters. It is highly important that test tubes with uniform thickness and color of walls, and uniform diameter, be used.

In comparing the relative adhesiveness of dusts and bordeaux mixtures, both greenhouse and field experiments were conducted. The field determinations were made by comparing the results of copper tests from the foliage of plots under different treatments. The greenhouse experiments were conducted under more accurately controlled conditions with reference to the uniformity in amount and distribution of the fungicides upon the plants. In the greenhouse investigations, potato plants uniform in size were dusted or sprayed, on both the upper and the lower surfaces of the leaves, with equal amounts of the material for each plant. After the fungicide had dried on the foliage, the foliage was tested for copper before and after washings. Half of the leaves of each plant were removed before the washing. In all cases the washing consisted of a slow shower of 3 or 4 liters of water for each plant. The dusting and the spraying of glass plates were also included in the investigations conducted in the greenhouse.

DUST ON WET FOLIAGE COMPARED WITH SPRAY ON DRY FOLIAGE

Greenhouse experiments

Experiments conducted in the greenhouse, on both potato foliage and glass plates, indicate that the coating from bordeaux mixture 4-4-50 sprayed on dry surfaces is more resistant to the washing action of artificial rains, than the covering formed by dusting wet surfaces with a copper-lime dust containing 10 per cent of copper. In the experiment in which glass slides were dusted and sprayed (table 2), there seems to be a significant difference,[6] a little more than 15 per cent, in the percentage of copper that

[6] The probable error given in the tables throughout this paper was computed with Bessel's formula,

$$P. E._{M} = \pm 0.6745\sqrt{\frac{\Sigma d^2}{n(n-1)}}$$

Where the results of two treatments were to be compared, the treatments were usually made so that they could be compared in pairs. The difference was taken between the two treatments of a pair. These differences were then averaged and the probable error of the mean was computed from the individual differences. It is believed that in this way, especially when the method is applied to field experiments, the effects on the results of the variations due to soil and climatic conditions from one part of a field to another, and from one field to another, as well as from one year to another, can be minimized.

TABLE 2. RESULTS OF EXPERIMENTS TO COMPARE THE ADHESION OF COPPER-LIME DUST AND BORDEAUX SPRAY TO GLASS PLATES

Experiment no.	Milligrams of copper per square meter of plate				Per cent of copper adhering after washing	
	Dusted		Sprayed			
	Before washing	After washing	Before washing	After washing	Dusted	Sprayed
1	2.94	2 20	2 64	2 33	74 83	88.26
2	4 50	4.10	3 35	3.35	91.11	100.00
3	3 00	2.15	1 83	1.61	71 67	87.98
4	1.95	1 40	2.25	2 14	71.79	95.11

Average difference in percentage of copper remaining on the glass plates = 15.48 ± 1.923, in favor of the spray

remained after the washing, in favor of the spray. In the experiment in which the comparison was made on potato leaves (table 3), the difference, while not so great, appears to be regular and significant throughout the five tests. In this case the average difference in the percentage of total copper

TABLE 3. RESULTS OF EXPERIMENTS TO COMPARE THE ADHESION OF COPPER-LIME DUST AND BORDEAUX SPRAY TO POTATO FOLIAGE IN THE GREENHOUSE*

Experiment no.	Milligrams of copper per 100 grams of green leaves				Per cent of copper remaining on leaves	
	Dusted		Sprayed			
	Before washing	After washing	Before washing	After washing	Dusted	Sprayed
1	120	85	138	115	70.83	83.33
2	140	100	100	85	71 43	85.00
3	160	125	88	80	78.13	90 91
4	180	140	144	117	77.78	81.25
5	105	83	90	80	79.05	88.91

Average difference in percentage of copper remaining on the foliage = 10.44 ± 1.25, in favor of the spray

*Irish Cobbler potato plants were used in the first two experiments, and Bliss Triumph in the others.

adhering was slightly above 10 per cent in favor of the spray. In comparing the data in tables 2 and 3, it is seen that the degree of adhesiveness in the case of the dust is about the same on the glass slides and on the leaves, while the spray seems slightly more adhesive to the glass plates than to the foliage.

Field experiments

During the season of 1922, field tests with copper were made from two experiments which involved the dusting of wet foliage and the spraying

of dry foliage. The experiments were conducted at Bridgehampton and Southampton, Long Island. Each experiment included six dusted, six sprayed, and three check plots. At each farm an engine-driven potato duster and a traction sprayer, each with two nozzles per row, were employed. Copper determinations were made from representative samples of leaves taken from the dusted and the sprayed plots before and after successive applications, beginning with the third application.

Results of individual copper tests, together with the dates of the applications of the fungicides, are given in tables 4 and 5 and in figure 5.

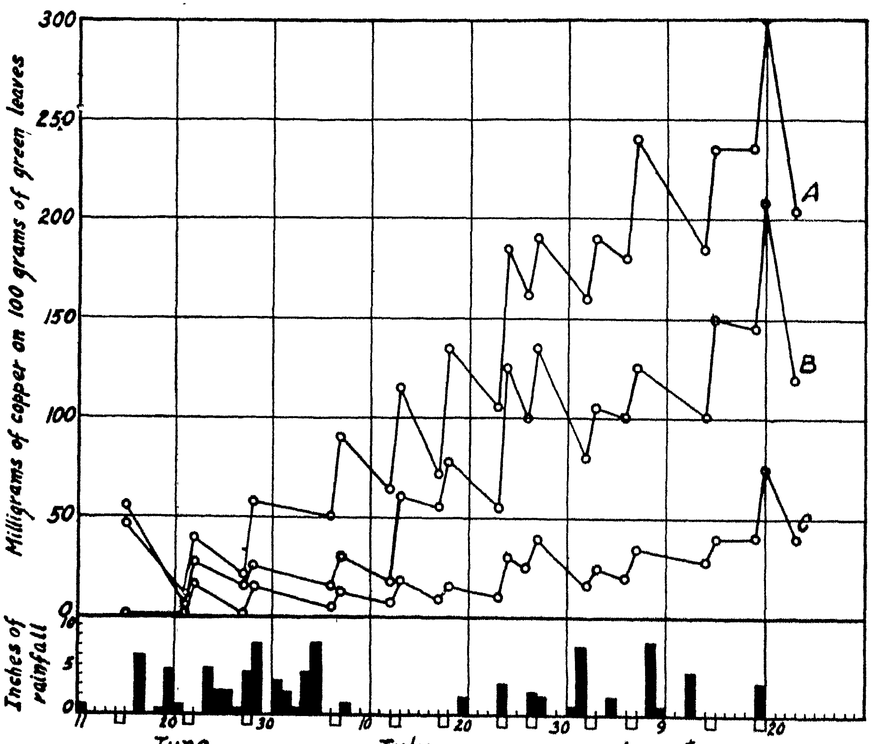


FIGURE 5. RESULTS OF INDIVIDUAL COPPER TESTS MADE ON FOLIAGE (A) SPRAYED WITH BORDEAUX MIXTURE, (B) DUSTED WITH A COPPER-LIME DUST WHEN THE FOLIAGE WAS DAMP, AND (C) DUSTED WITH A COPPER-LIME DUST WHEN THE FOLIAGE WAS DRY, WHEN APPROXIMATELY EQUAL AMOUNTS OF COPPER WERE APPLIED PER ACRE IN EACH TEST

RAINFALL DATA

Date	Inches	Date	Inches	Date	Inches	Date	Inches
June 11......	0.1	June 26......	0.23	July 4......	0.42	July 31....	0.1
17......	0.6	27......	0.07	5......	0.71	August 1....	0.7
19......	0.05	28......	0.42	8......	0.12	4....	0.2
20......	0.45	29......	0.71	20......	0.2	8....	0.75
21......	0.1	July 1......	0 35	24......	0.32	9....	0.1
24......	0.48	2.....	0 23	27......	0 25	12....	0.45
25......	0.25	3......	0.07	28......	0.2	19....	0.35

TABLE 4. RESULTS OF COPPER TESTS IN FIELD EXPERIMENT 1, ON LEAVES SPRAYED WHEN DRY WITH BORDEAUX 6-4-50, AND ON LEAVES DUSTED WHEN DAMP WITH COPPER-LIME DUSTS CONTAINING 8½ AND 10 PER CENT OF COPPER, 1922

Applications		Pounds of copper applied per acre		Milligrams of copper on 100 grams of green leaves					
				Foliage sprayed			Foliage dusted		
Date	No.	In spray	In dust	Before application	After application	Amount retained	Before application	After application	Amount retained
June 10	1	4 90	3.33	......	......	......	......	......	......
15	2	3.00	3.17	......	47	......	......	56.2	......
22	3	2 55	3.70	11.7	42	30.3	6.2	26 5	20.3
28	4	3.80	4.00	21 5	59	37.5	15.0	26.6	11.6
July 7	5	3.70	3.00	50.0	90	40.0	16.0	31.0	15.0
13	6	3.90	4.10	63 0	115	52.0	17.0	60.0	43.0
18	7	3 70	3.20	72.0	137	65.0	55.0	78.0	23.0
24	8	4.85	4 85	106.0	187	81.0	56.0	125.0	69.0
27	9	3.50	3.50	162 0	190	28.0	100.0	137.0	37.0
August 2	10	4.75	3.50	160.0	190	30.0	81.0	105.0	24.0
7	11	2.80	2.10	180.0	240	60.0	100.0	125.0	25.0
14	12	5.40	6.00	185.0	235	50.0	100.0	150.0	50.0
19	13	3.80	4.10	235.0	300	65.0	145.0	210.0	65.0
22*	....	......	......	205.0	......	......	120.0	......	.....

* On August 22 the final test for copper was made. No application was made on this date.

TABLE 5. RESULTS OF COPPER TESTS IN FIELD EXPERIMENT 2, ON LEAVES SPRAYED WHEN DRY WITH BORDEAUX 6-4-50, AND ON LEAVES DUSTED WHEN DAMP WITH COPPER-LIME DUSTS CONTAINING 8½ AND 10 PER CENT OF COPPER, 1922

Applications		Pounds of copper applied per acre		Milligrams of copper on 100 grams of green leaves					
				Foliage sprayed			Foliage dusted		
Date	No.	In spray	In dust	Before application	After application	Amount retained	Before application	After application	Amount retained
June 12	1	2.75	3.0	.....	......	......	......	......	......
17	2	2.90	6.0	.....	56	......	......	90.0	......
21	3	3.00	5.0	18	42	24	15	39.0	24.0
27	4	3 00	4 4	20	62	42	16	62.0	46.0
July 3	5	3.45	3.6	25	45	20	25	37.5	12.5
8	6	3.00	5.0	35	70	35	26	62.0	36.0
14	7	3 00	4.6	44	72	28	31	67.0	36.0
19	8	3.80	4.4	71	115	44	65	100.0	35.0
25	9	4 40	5.2	106	144	38	90	130.0	40.0
28	10	3.00	3.0	130	190	60	100	137.0	37.0
August 4	11	4.00	4.7	106	200	94	78	120.0	42.0
8	12	4.25	3.6	190	230	40	105	140.0	35.0
11	13	4.00	5.0	200	265	65	110	170 0	60.0
16	14	3 00	3.0	240	275	35	150	180 0	30.0

A summary of the data for the copper tests is given in table 6, showing averages based on the determinations for each application. The difference in the amount of copper retained by the dusted and the sprayed foliage was determined by comparing the number of milligrams of copper retained by 100 grams of leaves for each pound of copper applied per acre in each application. Likewise, the difference in the adhesiveness of the dust and the spray was determined by comparing the relative losses of copper which occurred after each application and before the following one, and then averaging the differences. Due to the fact that equivalent amounts of copper in the dusts and the sprays were not always applied in corresponding applications, the values obtained from the copper tests were reduced to milligrams of copper for each unit pound of copper applied per acre.

TABLE 6. SUMMARY OF DATA SHOWING THE RELATIVE ADHESIVENESS OF BORDEAUX MIXTURE TO DRY FOLIAGE AND OF COPPER-LIME DUST TO DAMP FOLIAGE

Experiment no.	Average number of pounds of copper applied per acre at each application		Average number of milligrams of copper on 100 grams of green leaves for each pound of copper applied per acre					
			Retained during the application			Washed off before the following application		
	In spray	In dust	Spray	Dust	Difference	Spray	Dust	Difference
1	3.88	3.82	12.93	8.98	3.95 ±1.25	8.87	6.89	1.98 ±0.91
2	3.53	4.40	12.56	8.40	4.16 ±0.81	7.35	6.00	1.35 ±0.61

It will be observed, from the data in table 6, that in both experiments considerably more copper was retained by the foliage from the spray than from the dust, the difference in each experiment being more than three times its probable error. The amount of copper that was lost between applications was also larger with the sprayed foliage, due presumably to the proportionately greater quantity that was retained by the leaves. These differences, however, which indicate a greater loss of copper in the sprays than in the dusts, are considerably less than three times their probable errors, and their significance is therefore questionable. The percentage of copper that remained on the foliage after washings between applications was greater on the sprayed plants in both experiments, but it was significantly larger only in experiment 2, in which the difference was more than three times its probable error. It will be seen from the data in table 5 that, although there was more copper applied in the dust than in the spray throughout the season, the last copper test for experiment 2 showed about 52.8 per cent more copper on the leaves sprayed with bordeaux mixture than on the dusted leaves. Likewise, in the case of experiment 1, as shown in table 4, the copper test that was made immediately after the last application showed about 43 per cent more copper on the sprayed leaves, and the last test showed about 71 per cent more.

DUST ON WET AND ON DRY FOLIAGE

Greenhouse experiments

In order to determine the relative amounts of dust that would be retained by dry foliage and by wet foliage, twelve Bliss Triumph plants were dusted with an equal amount of a copper-lime dust containing 9 per cent of copper. Six of these plants were previously sprayed uniformly with water, and the remainder were left dry. The results of four experiments, expressed in milligrams of copper retained on 100 grams of green leaves, were as follows:

Experiment	On wet foliage	On dry foliage
1	40	20
2	180	80
3	190	95
4	92	45

These data indicate that, under such conditions, moistened leaves will retain about twice as much dust as will dry leaves, when equal amounts of

the dust are applied. Therefore, in order to get a certain amount of dust on the leaves, it is necessary to use twice as much material when the vines are dry.

In the experiments discussed above, it was observed that when leaves which were dusted when dry were moistened subsequently with a fine spray of water, in an amount just sufficient to allow the fungicide to "set" but not enough to permit an accumulation of large drops or any dripping, the dust coating that resulted after the foliage had dried was more evenly distributed over the surface of the leaflets than the covering on foliage that was dusted when moist. With this in mind, experiments were next conducted to determine whether there was any difference in the adhesiveness of a copper-lime dust when applied to wet foliage and when applied to dry leaves that were moistened subsequently. The plants that were dusted dry were divided into two series, one of which was moistened immediately and the other on the following day. There were six plants in each series, in each experiment. Before the plants were subjected to an artificial rain, half of the leaves were removed for controls. Green Mountain plants were used in the first experiment, and Bliss Triumph plants in the others.

The results of the copper tests for the plants dusted when dry are given in table 7, and those for the plants dusted when wet are given in table 3 (page 11). Only in the third trial was there any indication that a delay

TABLE 7. RESULTS OF COPPER TESTS TO DETERMINE THE EFFECT OF SUBSEQUENT WETTING OF FOLIAGE ON THE ADHESIVENESS OF A COPPER-LIME DUST, CONTAINING 10 PER CENT OF COPPER, APPLIED TO DRY FOLIAGE

Experiment no.	Milligrams of copper on 100 grams of green leaves				Per cent of copper remaining after washing	
	On plants moistened immediately after the dusting		On plants moistened one day after the dusting		Immediate wetting	Delayed wetting
	Before washing	After washing	Before washing	After washing		
1	110	95	110	90	86.36	81.81
2	60	50	60	50	83.33	83.33
3	60	48	60	38	80.00	63.33

of twenty-four hours in converting the dust into a bordeaux coating brought about a material decrease in the adhesiveness of the copper. In comparing the data in the two tables, it appears that, although about twice as much dust was retained by wet foliage as by dry foliage, the dust was slightly more adhesive when the leaves were moistened after the application. This slight difference was probably due to the better distribution of the material on the dry leaves. In order to obtain further information on this question, glass slides were dusted, one series being sprayed uniformly with water prior to the application, and the other being sprayed after the application. The percentage of copper that remained after the artificial rainfall was as follows:

Experiment 1.	Slides moistened before dusting...........78.26 per cent
	Slides moistened immediately after dusting.80.70 per cent
	Slides moistened 24 hours after dusting....82.60 per cent
Experiment 2.	Slides moistened before dusting...........85.33 per cent
	Slides moistened immediately after dusting.86.66 per cent
	Slides moistened 24 hours after dusting....84.50 per cent

Since there is no significant difference between the values in either of the experiments, it is doubtful whether the time of wetting the dust has any influence on its adhesiveness, as long as a good distribution of material is insured. It is obvious, however, that if the foliage is dusted when dripping wet or when holding large drops of water, the distribution of the dust is likely to be not so even as on dry leaves.

Field experiment

During the summer of 1922, an experiment was conducted to determine, under field conditions, the relative adhesiveness of copper-lime dust to wet and to dry foliage. Six plots were dusted with a four-row power machine in the early morning when the vines were wet with dew, and six plots in the early afternoon when the vines were dry; one plot was dusted with a hand duster, in the early morning. A curtain was used when the power duster was operated in the afternoon, to protect the nozzles from the wind. Since copper tests were made before and after each application, beginning with the third, it was possible to determine not only the relative amounts of dust retained by the leaves during the applications, but also the relative degrees of washing between the applications.

The results of the individual copper tests are given in tables 4 and 8.

TABLE 8. RESULTS OF COPPER TESTS MADE ON LEAVES DUSTED WHEN DAMP AND WHEN DRY WITH COPPER-LIME DUSTS CONTAINING 8½ AND 10 PER CENT OF COPPER; POWER DUSTER USED FOR THE DRY FOLIAGE AND HAND DUSTER FOR THE DAMP FOLIAGE

(See also table 4 for data on copper tests made on leaves dusted with power duster when damp)

Applications		Pounds of copper applied per acre		Milligrams of copper on 100 grams of green leaves					
				Dusted when damp			Dusted when dry		
Date	No.	To damp foliage	To dry foliage	Before application	After application	Amount retained	Before application	After application	Amount retained
June 10	1	3.0	3 33	......	......	......	......	......	......
15	2	2.5	3.19	......	40.5	......	......	Trace	......
22	3	3.0	3.70	10	28.0	18	Trace	15	14
28	4	4.0	4 00	15	32.0	17	Trace	15	14
July 5	5	3.5	3.00	20	48.0	28	4	12	8
13	6	3 6	4.10	22	62.0	40	7	18	11
18	7	3.0	3.20	57	75.0	18	8	15	7
24	8	4.1	4 85	61	121.0	60	12	30	18
27	9	3 0	3.50	102	130.0	28	25	39	14
August 3	10	3.5	3.50	87	120 0	33	16	26	10
7	11	2 5	2 10	112	139.0	27	20	34	14
14	12	5 0	6.00	121	171.0	50	28	40	12
19	13	4.0	4.10	159	224.0	65	40	75	35
22	....	...	......	130	......	......	40	......	......

The data recorded in table 8 are for foliage dusted when damp with the hand duster, and foliage dusted when dry with the power machine. The data for the tests made with the power machine on wet foliage, in the same experiment, are given in table 4 (page 13), together with the data for the sprayed plants. The plants that were dusted when the leaves were wet retained more than twice as much dust as did those that were dusted when the leaves were dry. Although a greater percentage of the copper retained by the wet leaves was washed off between applications, yet the amount accumulating as the season progressed was much greater, due to the greater quantity of dust that was retained during the applications. At the time when the last copper test was made, there was three times as much copper on the foliage that received applications when the vines were wet, as on that which was dusted when dry. The results showing the relative amounts of dust retained compare favorably with those of the greenhouse experiments, in which it was found that the damp foliage retained a little more than twice as much copper as did the dry leaves. According to the experiments with potted plants in the greenhouse, the coating that resulted from a copper-lime dust set with a thorough spray of water either immediately after the application to dry foliage or twenty-four hours later, was as resistant to washings as was the covering that resulted from an application on damp foliage. Under field conditions, there was a greater percentage loss of dust from foliage dusted when dry than from foliage dusted when wet, due probably to the fact that in some cases the dust would be blown or washed from the dry dusted foliage before it had time to set.

In comparing the data for the relative adhesion of the dust when applied with the power duster and with the hand machine (table 9), it is seen that

TABLE 9. SUMMARY OF DATA SHOWING THE RELATIVE ADHESION OF A COPPER-LIME DUST TO WET FOLIAGE AND TO DRY FOLIAGE

Average number of pounds of copper applied per acre at each application		Average number of milligrams of copper on 100 grams of green leaves for each pound of copper applied per acre					
		Retained during the application			Washed off before the following application		
With power duster	With hand duster	Wet foliage, power duster	Dry foliage, power duster	Wet foliage, hand duster	Wet foliage, power duster	Dry foliage, power duster	Wet foliage, hand duster
3.82	3.56	8.98	3.87	9.62	6.89	2.96	6.85
Increase for wet foliage over dry, power duster		5.11 ± 0.63			3.93 ± 0.98		
Increase or decrease with hand machine over or under power duster, wet foliage...		+0.64 ± 0.29			-0.04 ± 4.33		

slightly more dust was retained by the plants dusted with the hand machine and that there was practically no difference in the amount of copper that was lost between applications. Although the hand-dusted plot was treated always after the other plots in the experiment, and, on a few days, when the vines were drying off rapidly, yet it is not surprising to find that an equally efficient covering was secured throughout the season with the hand duster, because the distribution of dust from the latter was far superior to that obtained with the power machine.

COMPARISON OF VARIOUS COPPER DUSTS ON WET FOLIAGE

After studying the adhesiveness of the copper-lime dust in comparison with bordeaux mixture and when applied to damp and to dry foliage, the question arose regarding the relative efficiency of this dust, as correlated with this particular property, and of other dusts that do not contain their copper in the form of dehydrated copper sulfate.

With reference to the physical properties and fungicidal values of bordeaux powders and pastes, Lutman (1916) reports that the pastes are practically unchanged from the freshly prepared condition, and he considers them as valuable in fungicidal properties as the freshly prepared bordeaux mixture. The powders, on the other hand, he considers practically worthless as fungicides, since the precipitation membranes of the bordeaux preparation are changed, during the drying process, from the colloidal state into dry, shriveled forms, which, when re-wet, failed to regain any of their former covering and adhesive properties.

For the experiments to study this question, two dusts were chosen. One of these, known as "Copper-carb,"[7] was mixed with sufficient hydrated lime to represent the desired percentages of metallic copper. The other mixture was Sanders' green copper-arsenic dust,[8] which also does not contain copper in water-soluble form. This dust, as it was employed in these experiments, contained 9 per cent of metallic copper and 5 per cent of arsenic. It is very finely divided, and is guaranteed by the manufacturer to pass through a screen with 300 meshes to the inch.

When the copper-carbonate dust is applied to a wet surface, apparently no chemical change takes place. The colloidal membranes characteristic of bordeaux mixture and of copper-lime dust are not formed, nor are they formed when the green copper-arsenic dust is wetted. In the latter mixture a few membranes are generally present, as distinguished by the potassium-ferrocyanide stain, but they are not highly hydrated or gelatinous.

Greenhouse experiments

Both greenhouse and field trials were included in the comparison of the two proprietary dusts and the copper-lime dust. In the greenhouse, both on glass slides and on potato foliage the copper-lime dust proved superior to both the other mixtures, the copper-carbonate dust exhibiting the lowest degree of adhesiveness of the three. When equal weights of the three dusts,

[7] Copper-carb is a proprietary dust, containing 18 per cent of metallic copper in the form of carbonate, manufactured by the Corona Chemical Division, Pittsburgh Plate Glass Company, Milwaukee, Wisconsin.

[8] This is a proprietary dust, the formula for which was originated by G. E. Sanders, of Nova Scotia. The dust was supplied by the Dosch Chemical Company, of Louisville, Kentucky. As the writer understands it, during the initial steps in the preparation of the dust the three constituents—copper sulfate, calcium arsenate, and stone lime—are mixed and the lime is started to slaking.

containing equivalent percentages of copper and arsenic, were applied to the plants, approximately equal amounts were retained by the foliage in each case, either when the plants were wet or when they were dry. In table 10 are given data which represent the percentages of copper that remained

TABLE 10. RESULTS OF COPPER TESTS TO DETERMINE THE RELATIVE ADHESIVENESS OF DIFFERENT KINDS OF COPPER DUSTS TO POTATO FOLIAGE AND TO GLASS PLATES IN THE GREENHOUSE

Experiment no.	Per cent of copper in dusts	Per cent of total copper remaining after artificial rains					
		When copper-lime dust containing dehydrated copper sulfate was applied		When Sanders' green copper-arsenic dust with insoluble copper was applied		When Copper-carb diluted with hydrated lime was applied	
		Leaves	Glass	Leaves	Glass	Leaves	Glass
1	6	73 10	77.6	66.00	62.00	31.0	40.8
2	9	71 50	77.0	50.60	52.58	35.0	38.0
3*	9	80.25	86 8	69 91	75.21	......	......
4	6	88.24	. .	63.34	. . . .	......	......

*In this experiment the plants and the glass plates were dusted when dry, and were subsequently wetted.

after washings. In each experiment the copper-lime dust — that is, the one that produces colloidal copper-membranes when wet — exhibited the greatest degree of adhesiveness. The green copper-arsenic mixture, which is actually a kind of bordeaux powder, proved superior to the copper-carbonate dust, due probably to its finer texture. Furthermore, the copper-lime dust that contained 6 per cent of copper showed about the same degree of adhesiveness as did the one containing 9 per cent.

Field experiment

In 1922 a field experiment on Green Mountain potatoes was conducted, in which the following dusts were compared: copper-lime dust; copper-lime dust with "Kayso"[9]; copper-lime dust in which part of the hydrated lime was replaced by gypsum; and Copper-carb diluted with hydrated lime. Each mixture contained 10 per cent of metallic copper. Eleven applications were made, at intervals of about seven days and, with one exception, when the vines were thoroughly wet from dew or fog. Although there was no attempt to apply definite quantities of the dusts per acre, it was the intention to put on equal amounts in the different plots. Due to the irregularity in the rate of feeding with the mixtures containing gypsum and Copper-carb, however, the applications of those dusts varied more or less in amount from that in the other two dusts, and were usually greater. Each treatment included one two-row plot.

[9] Kayso is a casein spreader, furnished by the California Central Creameries, of New York City, and consisting of a mixture of one part of casein and two parts of hydrated lime.

The results of the individual copper tests, together with the accompanying averages, are given in table 11. The figures for the copper determination show that practically equivalent amounts of copper were retained in the copper-lime dusts with and without the casein spreader,

TABLE 11. RESULTS OF COPPER TESTS TO DETERMINE THE RELATIVE ADHESIVENESS OF DIFFERENT KINDS OF COPPER DUSTS APPLIED WITH A HAND DUSTER TO DAMP FOLIAGE IN THE FIELD

Dust applications		Milligrams of copper on 100 grams of green leaves on foliage dusted with							
		Copper-lime dust (10 per cent of copper)		Copper-lime dust with Kayso sticker (10 per cent of copper)		Copper-lime dust with gypsum as a diluent (10 per cent of copper)		Copper-carb with lime (10 per cent of copper)	
Date	No.	Before application	After application	Before application	After application	Before application	After application	Before application	After application
June 29	4	15	26	18	30	25	50	12	45
July 7	5	18	51	15	46	25	40	6	62
15	6	42	55	40	55	30	55	14	25
20	7	48	103	50	110	51	112	15	60
25	8	88	122	94	119	100	131	32	62
August 2	9	89	125	90	138	85	120	40	80
10	10	117	179	128	188	105	200	40	112
17	11	169	232	175	246	190	275	78	150
22	.	214	....	228	....	254	....	100	....
Average retained		38.38		40.25		46.50		44.88	

Average percentage of total copper present after each application, that was washed from the foliage before the following application:

Copper-lime dust	15.32	
Copper-lime dust with Kayso	16.57	
Increase over copper-lime dust	1.25	± 1.80
Copper-lime dust with gypsum	19.15	
Increase over copper-lime dust	3.83	± 1.92
Copper-carb with lime	49.99	
Increase over copper-lime dust	34.67	± 5.12

and the data in the tabulated averages indicate that there was no significant difference in the rate of washing. It seems, therefore, that the Kayso had no appreciable effect on the adhesiveness of the copper-lime dust.[10] The copper-lime mixture containing gypsum for a partial diluent showed no marked increase in the degree of washing over that for the dust without gypsum, even though the rate of application was considerably higher, as is indicated by the average number of milligrams of copper retained by the two dusts. The Copper-carb, on the other hand, which was applied at approximately the same rate as the gypsum dust, proved decidedly less adhesive to the foliage than did the other dusts. There was an average increase in the percentage of washing from the foliage, of 34.67 ± 5.12, over that for the copper-lime dust, which is undoubtedly a significant difference. In calculating the percentage of copper that was washed from

[10] When Kayso was added to bordeaux mixture, on the other hand, the spreading qualities of the spray were greatly increased, resulting in a continuous coating, or layer, of uniform thickness on the upper surface of the leaves and on the stalks and petioles. Copper tests made throughout the season, however, showed that there was no additional copper retained by the leaves during applications, and that there was no less washing from the foliage between applications.

the leaves between applications, the total amount present after each application was considered as 100 per cent. The results for the copper-carbonate dust agree rather closely with those obtained in dusting plants in the greenhouse, and indicate that such a dust, whose copper is in an insoluble form, does not possess as high a degree of adhesiveness when applied to wet foliage as one whose copper is converted into colloidal membranes.

RELATIVE TOXICITY OF BORDEAUX MIXTURE AND COPPER-LIME DUST TO PHYTOPHTHORA INFESTANS

The relative adhesiveness of copper-lime dust and of bordeaux mixture having been considered, attention was next turned to their relative fungicidal value. An attempt was made to determine the quantity of copper that was necessary in the fungicides to prevent germination and infection with zoospores of *Phytophthora infestans* (Mont.) de Bary.

In his publication of 1914, Butler (1914) included the results of some spore-germination tests conducted for him by Melhus. Melhus sprayed glass slides with bordeaux mixture in which the ratio of copper sulfate to calcium oxide varied between 5 and 0.5. After the slides had been allowed to stand for twenty-four hours, drops of spore suspensions containing the sporangia of *P. infestans* and *P. viticola* were applied. Melhus found that when tap water was used in preparing the mixtures, a mixture containing 0.5 per cent of copper sulfate was not toxic, but that when distilled water was employed, all of the mixtures, regardless of the ratio of copper sulfate to calcium oxide, were toxic at 0.0625 per cent of copper sulfate. The amount of copper present per unit of surface was not given.

In 1916, Butler (1916) offered further data indicating that the efficiency of unit copper is the same in neutral, alkaline, and acid bordeaux mixtures. When mixtures with ratios of copper sulfate to calcium oxide of 1:0.3, 1:1.5, and 1:2, and containing 1.97 milligrams of copper in 100 cubic centimeters, were sprayed on glass slides to give 0.075 milligram of copper to 1000 square centimeters, the coatings were not toxic to the direct[11] germination of the sporangia of *P. infestans*. Mixtures with ratios of 1:0.2, 1:0.3, and 1:2, and containing 3.95 milligrams of copper in 100 cubic centimeters, and representing 0.15 milligram of copper to 1000 square centimeters, prevented germination. The amount of copper to 1000 square centimeters, however, was designated as "indicative only." These germination tests also were conducted by Melhus.

Melhus (1915), in using the method described in the preceding paragraphs, presented data which showed that bordeaux mixtures containing copper sulfate and calcium oxide in the ratios of 1:1 and 1:2 prevented indirect germination of sporangia of *P. infestans* when they were diluted to contain about 0.015 per cent of copper sulfate, and permitted germination when they were represented by one-half that concentration. The amount of copper per unit of surface area was not stated.

Regarding the amount of copper in a bordeaux mixture required to control late blight of potatoes in the field, Butler (1920) reported that a 1-per-cent mixture of the ratio "1:05" (1:0.5?) is superior to a 1-per-cent

[11] By "direct" germination is meant the production of one or more germ tubes by the spore. "Indirect" germination refers to germination by the formation of zoospores.

mixture of the ratio 1:1, and that a 2-per-cent mixture of the ratio "1:05" (1:0.5?) applied at intervals of two weeks is superior to either of the 1-per-cent mixtures applied weekly. Bordeaux paste and Pyrox were less effective than freshly prepared bordeaux mixture. Butler estimated, by correlating the amounts of copper added during the season with the degree of control, that the quantity of copper which should be applied per acre in a season, in order to prevent losses from *P. infestans*, lies between twenty-four and twenty-six pounds. Unfortunately, the relative amount of late blight in the tops, and the comparative yields of the plots under different treatments, were not mentioned. Only the percentage of rotted tubers at digging time was considered in determining the merits of the different fungicides and of the methods used in applying them.

Cook (1920), in comparing the Pickering sprays with bordeaux mixtures for late-blight control, found that the Pickering spray containing the equivalent of 0.7 per cent of copper sulfate adhered as well to the foliage and controlled late blight as effectively as a 5-5-50 bordeaux preparation. The yield was the same in both cases. Cook concluded that the amount of copper necessary to control late blight might be reduced 44 per cent by using Pickering's spray.

It is evident from the foregoing citations that under laboratory conditions the quantity of copper in bordeaux form necessary to prevent sporangium germination in *P. infestans* is exceedingly low. Melhus (1915), in referring to this point, makes the following statement: "The most efficient 2-per-cent Bordeaux mixtures contain nearly 200 times as much copper sulphate as is needed to prevent indirect germination of the spores of *Phytophthora infestans*. This suggests that a reduction in the amount of copper sulphate can be made in Bordeaux mixture used for the control of Phytophthora if these laboratory tests are a true representation of conditions existing in the open." The results of Butler's field experiments previously referred to, in connection with which Butler recommended from 24 to 26 pounds of copper sulfate in a season for late-blight control, do not seem to bear out the probability suggested by Melhus.

The writer was unable to find any reports on investigations conducted for the purpose of determining the amount of copper per unit of leaf area, in the form of bordeaux mixture or of any other copper fungicide, which is necessary to furnish protection to the potato plant against infection from the late-blight fungus. In order to gather some information concerning this question, experiments were conducted with the object of determining the amount of copper in the form of bordeaux mixture that is required to prevent germination of zoospores in the laboratory, and the amount necessary to prevent infection in the greenhouse. A copper-lime dust was included in the experiments in order to compare its fungicidal value with that of the bordeaux preparation. An undetermined species of Phytophthora was included with *Phytophthora infestans* in the germination tests. The following methods were employed.

In the spore-germination experiments, glass slides, each with an area of 15.5 square centimeters, were dusted with a copper-lime dust containing 9 per cent of copper, and were sprayed with various dilutions made from a 4-4-50 bordeaux mixture prepared from tap water, freshly hydrated lime, and a stock solution of chemically pure copper sulfate in distilled water. The copper-sulfate solution had previouly been analyzed for copper content.

The greatest precautions were observed in the attempt to apply an equal amount of spray to each slide, and equal amounts of dust to the dusted slides. Preliminary copper tests were made in order to determine the uniformity of the copper coatings on the several slides in a series, before germination tests were undertaken. It was found that by dusting the dry slides and wetting them afterward with a fine spray of water, a better distribution of material could be obtained on a single slide than could be obtained by dusting slides which had previously been sprayed with water. Both the dusted and the sprayed slides were allowed to stand for twenty-four hours, after which period each series was divided into two lots. One lot was employed in the germination tests, and the other was used for the copper determinations.

The spore material in the germination tests included fresh sporangia from diseased leaves of potted potato plants growing in the greenhouse, in the case of *Phytophthora infestans*, and sporangia taken from agar cultures, in the case of the unknown species. The method of obtaining zoospores was essentially that described by Melhus (1915). Only cultures containing large numbers of motile zoospores were used. From eight to twelve drops of the spore suspension were placed on a slide, which was then incubated at 23° C. for from five to ten hours. If unsatisfactory germination occurred on the control slides, the entire experiment which involved the use of the particular spore material concerned was discarded. On the treated slides, if germination occurred in 75 per cent or more of the drops the results were considered positive; if there was no germination, or only a trace, the results were listed as negative.

The method of spraying the slides with different dilutions of the bordeaux mixture, accompanied by an accurate determination of the copper on the sprayed surface, was employed only in a sufficient number of trials to prove beyond question that such a method might be used to advantage.

The amount of copper per square meter (as determined by the colorimetric method) which was necessary to prevent germination of the zoospores, was checked against the amount which proved toxic when measured quantities of the same dilutions of bordeaux mixture were pipetted upon slides. In the latter case, the amount of copper per unit area of surface was controlled, while in the former it had to be determined. Since it was possible to obtain like results with the same amount of bordeaux copper, whether the mixtures were sprayed uniformly on the slide or spread out in a thin film, the latter method was adopted for a majority of the germination experiments. By using this method, the more or less tedious procedure involved in the copper determinations was eliminated.

In order to utilize the "controlled" method to the best advantage, it was necessary to select glass slides on which the diluted bordeaux mixture could be spread out into a film of uniform thickness.[12] Before the bordeaux dilutions were pipetted on the slides, they were first sprayed into a vessel, by the use of a small hand sprayer, in order that any rupturing of the membranes such as might occur during spraying would be simulated. One-tenth of a cubic centimeter of the dilution was then pipetted on a slide and spread out evenly, and the slide was placed on a level surface to

[12] For this purpose, a grade of glass slide was used which on being heated over a flame underwent surface cracking to the extent that the effect resembled etching. It was thereby possible to spread a few drops of the spray mixture evenly over the surface.

dry. After a period of twenty-four hours, drops of spore suspensions were placed on the slides and the slides were placed in the incubator.

For the infection experiments in the greenhouse, three varieties of potatoes were used—Irish Cobbler, Green Mountain, and Bliss Triumph. Since the amount of copper found to be necessary for control of the blight was the same for all three, no further consideration is given to the separate varieties in discussing methods and results. Plants of the same age and size were selected for each experiment, and there was little difference in the size of the plants in all of the experiments. The fungicides were the same as those used in the spore-germination tests. Before the plants were treated, a few leaves were removed from each plant in order that the remaining leaves might be better exposed to the application of the fungicides. To insure the application of equal quantities of material to the different leaves of a plant and to the leaves of the other plants in the same series, only one side of one or two leaves was sprayed or dusted at a time. By this method, each side of every leaf received the same amount of the fungicide. Copper tests made from preliminary trials showed that remarkably uniform amounts of copper per square decimeter were applied to the different leaves of a plant or of a series of plants. As a rule, each inoculation series sprayed with a given dilution of bordeaux mixture consisted of four plants, two for copper tests and two for inoculations. In all of the experiments, inoculations were made with zoospores on both the upper and the lower surface of the leaves.

The quantity of copper per square meter of leaf surface was determined by measuring the area of the leaves with a planimeter, and then dissolving the copper from the leaves with the nitric-acid wash. The volume of the wash was reduced to a minimum, only two or three leaves being treated at one time, in order that the color developing in the wash might be sufficiently intense to furnish a fair comparison with the standards.

SPORE-GERMINATION TESTS

The results of the germination tests with bordeaux dilutions (table 12) indicate that the amount of copper required to inhibit germination of zoospores is even less than the amount reported by Butler (1916) as necessary

TABLE 12. RESULTS OF EXPERIMENTS TO DETERMINE THE AMOUNT OF COPPER IN BORDEAUX MIXTURE NECESSARY TO PREVENT GERMINATION OF ZOOSPORES OF PHYTOPHTHORA INFESTANS ON GLASS SLIDES

Experiment no.	Control	Concentration of bordeaux mixture: 1 cubic centimeter (2.47 milligrams of copper) diluted to							
		512 cc		1024 cc		2048 cc		4096 cc	
	Average length of germ tubes (microns)	Milligrams of copper per square meter	Average length of germ tubes (microns)	Milligrams of copper per square meter	Average length of germ tubes (microns)	Milligrams of copper per square meter	Average length of germ tubes (microns)	Milligrams of copper per square meter	Average length of germ tubes (microns)
1	100	0.311	0	0.155	12	......	....	0.0357	100
2	85	0.311	0	0.155	16	0.0775	60	0.0357	80
3	120	0.311	0	0.155	25	0.0775	40	0.0357	100
4	85	0.311	.....	0.155	0	0.0775	45	0.0357	75
5	175	0.311	0	0.155	40	0.0775	100	0.0357	100

to prevent indirect germination of the sporangia of the same fungus. Butler gives the inhibiting concentration as equivalent to 1.15 milligrams per square meter, and the nearest concentration that is not toxic as 0.75 milligram per square meter. In the present investigations, the inhibiting point might be considered a concentration of 0.311 milligram of copper per square meter, and the nearest point not toxic as 0.155 milligram. This difference is not surprising, since sporangia were under consideration in Butler's work, and zoospores in the present work.

Throughout the germination experiments the unknown species of Phytophthora, which makes a rather vigorous growth on oatmeal agar and develops oospores abundantly on the same medium, was more resistant to the toxic action of the bordeaux mixture than was *Phytopthhora infestans*. The concentration of copper required to inhibit germination of its zoospores was 1.08 milligrams per square meter, and in the control cultures its germ tubes were at least twice as long, after a given incubation period, as those of *Phytophthora infestans*.

Fortunately, it was through the use of this undetermined species of Phytophthora in the germination tests that a bare possibility was realized in comparing the copper-lime dust with the bordeaux mixture for the relative toxicity of unit copper contained. It is possible to dilute the liquid bordeaux mixture at will, thereby obtaining any strength desired. A dust, on the other hand, is difficult to dilute. The only feasible means of applying an extremely light application of a copper-lime dust containing, for example, 9 per cent of copper, is to allow the dust cloud discharged from the nozzle to strike the slide in a highly dispersed condition. Even when such a method is used, the particles of copper are not broken up and multiplied many times, either before they reach the surface to be dusted or after they have become wet on the surface, as is the case with a highly diluted bordeaux mixture. It was found that with the lightest application of dust on a slide which represented a uniform covering of the surface, the inhibiting point of zoospore germination for *Phytophhtora infestans* could not be passed. In other words, an application, while thoroughly covering the surface, could not be made light enough to permit germination. It was possible, however, to make such a light application in the germination tests involving the undetermined species of Phytophthora. The range of inhibition varied between 6.21 milligrams and 3.10 milligrams per square meter. At all concentrations below 3.10 milligrams, germination occurred. Since no germination in this species was obtained on the slides with the bordeaux mixture containing 1.01 milligrams of copper per square meter, it appears that with the dilution of the bordeaux mixture representing that concentration of copper (1 cubic centimeter of 4–4–50 diluted to 144 cubic centimeters) the liquid bordeaux mixture is from three to six times as toxic, per unit of copper, as is the dust. It seems probable, however, that if such comparisons could be successfully carried out with much lower dilutions of bordeaux mixture—say with a $\frac{1}{2}$–$\frac{1}{2}$–50 or a 1–1–50 concentration, in which the colloidal membranes approach nearer in form and character to those of the dust—even this slight difference in relative toxicity of the two fungicides might be further reduced.

INFECTION EXPERIMENTS

The results of the greenhouse experiments (table 13) indicate, as a whole, that about twice as much copper in the form of a dilute bordeaux mixture is necessary to prevent infection by zoospores, as is required to inhibit germination on glass slides. The correlation of the two amounts is indeed striking, and suggests that when the comparison is made in the range of such high dilutions there is, after all, a very slight difference in the amounts of copper that are necessary for control in the two cases.

TABLE 13. RESULTS OF EXPERIMENTS TO DETERMINE, UNDER GREENHOUSE CONDITIONS, THE AMOUNT OF COPPER IN BORDEAUX MIXTURE NECESSARY TO PREVENT INFECTION OF POTATOES BY ZOOSPORES OF PHYTOPHTHORA INFESTANS

Concentration of bordeaux mixture sprayed upon the leaves: 1 cubic centimeter (2.47 milligrams of copper) diluted to									
64 cc		128 cc		256 cc		512 cc		1024 cc	
Milligrams of copper per square meter	Degree of infection	Milligrams of copper per square meter	Degree of infection	Milligrams of copper per square meter	Degree of infection	Milligrams of copper per square meter	Degree of infection	Milligrams of copper per square meter	Degree of infection
1.9	None	....	....	0.470	Light	0.240	Medium	0.120	Heavy
1.6	Trace	0.800	None	0.400	Medium	0.200	Heavy	0.100	Heavy
1.5	None	0.750	None	0.375	Light	0.185	Heavy	0.097	Heavy
1.2	Trace	0.600	Trace	0.300	Medium	0.150	Heavy	0.075	Heavy
1.3	None	0.660	None	0.330	Light	0.165	Light	0.082	Heavy
1.25	None	0.625	Trace	0.312	Trace	0.156	Medium	0.078	Heavy
0.93	None	0.460	Trace	0.230	Medium	0.115	Heavy	......	....

In determining the amount of copper in the copper-lime dust necessary to furnish protection to foliage, the same difficulty was found in the inoculation experiments as in the germination tests. In all trials when the applications made were extremely light, yet heavy enough to produce a uniform distribution on the leaves, and the dust was allowed to set by the application of a light spray of water, no infection resulted when the plants were inoculated. The leaves of a plant dusted in that manner showed from 10 to 15 milligrams of copper per square meter. These values, although small indeed and not representing the lower point of toxicity, are about 15 to 20 times higher than the lower limit for protection with a diluted bordeaux mixture.

If the results of the infection experiments in the greenhouse were applied to field conditions, and if all parts of the potato plant could be kept covered with the bordeaux preparation, a very small quantity of copper would be sufficient to insure protection against the late-blight organism. While the matter of loss from the foliage due to washing by rains and heavy dews or fogs must be taken into account, yet it has been shown that if the dust or the spray is applied in such a manner as to give a thorough distribution of the fungicide, only about 15 to 25 per cent is lost during a vigorous washing. Judging merely from the greenhouse experiments, it would seem advisable to emphasize the importance of keeping all parts of the plant covered by a thorough distribution of the material with frequent applications, rather than the encouragement of heavy applications of copper at longer intervals.

The question of insect control, however, might necessarily modify the requirements for general spraying operations. There is need of further experimentation in the field to determine more accurately the amount of copper required in a bordeaux mixture and other fungicides used on potatoes, and the frequency of applications necessary to control fungous diseases and insect pests.

EXPERIMENTS WITH DUSTS AND SPRAYS[13]

Prior to 1920, the use of Sanders' copper-lime dust had received only scant attention aside from the experimental work conducted in Nova Scotia and New Brunswick, Canada, where the fungicide was developed. In 1918, Sanders and Kelsall (1918) published an article on this dust, which had then been only recently developed by Sanders, giving directions for preparing the mixture and reporting some results on dusting and spraying experiments with potatoes. Concerning those experiments, they stated that a copper-lime dust containing 5 per cent of copper and 2 per cent of arsenic controlled late blight effectively at Fredericton, the dusted plot yielding 396 bushels per acre as against 407 bushels for the average of 24 plots sprayed with 4–4–50 bordeaux mixture and 238 bushels for the check plots. At Truro, the dusted plot yielded 744 bushels per acre, the sprayed plot 652 bushels, and the check plots 550 bushels. In two other experiments Sanders and Kelsall reported that the dusted plots produced as high yields as did the sprayed plots. They expressed the opinion, however, that there was a greater waste of material in dusting than in spraying.

In a further report on the new copper-lime dust, Sanders and Kelsall (1920) state that at Fredericton the dust again gave yields as high as those obtained with bordeaux spray, but the control of late blight was not perfect unless the dust mixture contained 5 per cent of metallic copper or more. They reported that a 7.5–2 mixture — that is, one containing 7.5 per cent of copper and 2 per cent of arsenic — gave better protection against late blight and rot than did a 5–2 dust. They were of the opinion that calcium arsenate is much more effective in the dust than in a spray mixture.

In 1919 the Department of Plant Pathology at Cornell University, through two of its temporary field laboratories, conducted preliminary experiments in potato dusting and spraying. One of these laboratories was located in Dutchess County, New York, and the other in Nassau County. Promising results were obtained in each county with the copper-lime dust, and in the following year experiments were conducted in five field laboratories by industrial fellows. In each county, however, potato dusting was only one of several projects undertaken, and experiments were planned and carried out in a preliminary way. Again results were obtained that appeared encouraging for the dust in the control of late blight and flea beetles.

In 1921 the fellowship investigations were continued in three of the field laboratories. In general, the results were similar to those obtained

[13] The studies reported in this bulletin were terminated in July, 1923, and the manuscript was then placed in essentially its present form. Due to unavoidable delays, it has not been possible to publish it at an earlier date. In the interim, several publications on the relative merits of sprays and dusts for potatoes have appeared. In addition to an article by F. C. Stewart and P. J. Parrott (Dusting vs. spraying. *In* Experiments with potatoes, New York [Geneva] Agricultural Experiment Station, Bul. 518:3-29. 1924), in which certain references to recent literature are to be found, the publications of Martin (1924), Dimock (1924), and Wallace (1924), should be noted. Because of the availability of these articles, and the further delay in publishing this paper if a review of them were incorporated herein, it is felt that this brief note is sufficient.—L. M. MASSEY.

during the preceding summer.[14] Only in Suffolk County and Washington County were the investigations confined to potato protection, and a consideration of those experiments is included in this paper.

The experiments conducted in Suffolk County extended over a period of three years and were located at Bridgehampton and Southampton, two potato-growing sections on the south shore of Long Island. During the summer months the weather conditions there are, as a rule, favorable for the development of late blight. The cool nights with heavy dews and fogs, alternating with moderately warm, windy days, furnish ideal conditions for infection. Flea beetles are generally present throughout the growing season, and aphids become destructive in certain years.

In the sections of Washington County where additional experiments were conducted in 1921, the days were generally very warm and dry, and the nights were only moderately cool and with less moisture than in Suffolk County. During that particular summer, no traces of late blight were observed in any of the experiments. Injuries from tipburn and insects, however, constituted an important factor in the experiments.

COPPER-LIME DUST COMPARED WITH BORDEAUX MIXTURE

Experiments of 1920

In 1920, experiments of a preliminary nature were undertaken to compare lime-bordeaux, "bordeaux-lead,"[15] and sal-soda-bordeaux, with Sanders' copper-lime dust in the control of potato diseases and pests. Sal-soda-bordeaux is the spray mixture commonly used in the Bridgehampton potato section, while the use of lime-bordeaux predominates at Southampton. The sprayers and spray materials used were those ordinarily employed by the three growers who cooperated. The duster used in each case was a Niagara hand blower-gun. In experiment 1, a Union Leader power machine carrying from 180 to 200 pounds pressure was used. In experiments 2 and 3, traction sprayers furnishing about 150 pounds pressure were employed. Each sprayer was equipped with one nozzle to a row. No attempt was made to apply equal amounts of copper in the different fungicides under comparison. A record was kept, however, of the amount of materials used on the plots of the three experiments, and this is included, together with the size, number, and yield of the plots, in tables 14 and 15. All dust applications were made early in the day while the vines were still moist from dew or fog. The spray applications were made later in the same day, on dry foliage. The first two applications in each experiment contained poison for bugs. The season as a whole was highly favorable for the development of late blight, and was further characterized by general injury from flea beetles and tipburn.

Experiment 1 (Farm of H. T. Fahy, Bridgehampton, New York).— The potato field used in the first experiment was 48 rods long. The arrangement of the plots is indicated in table 14. The sprayer used was an engine-power Union Leader carrying six nozzles, one to a row.

Late blight, the only fungous disease of any consequence, made its appearance in the plots about June 25. The infection spread rapidly in

[14] The dusting and spraying results for 1920 and 1921 were summarized in mimeographed reports and distributed by the Department of Plant Pathology.
[15] See footnote 5, page 9.

TABLE 14. YIELD OF GREEN MOUNTAIN POTATOES DUSTED AND SPRAYED IN EXPERIMENT 1, 1920

(Farm of H. T. Fahy, Bridgehampton, New York)

Fungicides	Rate of application per acre	Number of rows in plots	Number of applications	Yield, in bushels per acre	Increase or decrease in yield over or under the two nearest soda-bordeaux plots	
					Bushels per acre	Per cent
Soda-bordeaux, 6-7-50	75 gals...	12	10	238	....	....
Copper-lime dust:						
6 per cent of copper.	48 lbs....	12	10	287	+37.5	+15.00
6 per cent of copper.	48 lbs....	4	6	252	−5.3	−2.03
Soda-bordeaux, 6-7-50	75 gals...	12	10	265	....	....
Bordeaux-lead dust:						
6 per cent of copper.	48 lbs...	8	10	267	+15.4	+6.12
6 per cent of copper.	48 lbs....	4	6	223	−20.6	−8.45
Soda-bordeaux, 6-7-50	75 gals...	12	10	169*	....	....
Check	....	6	......	103	−118.0	−53.40
Soda-bordeaux, 6-7-50	75 gals...	12	10	209	....	....
Lime-bordeaux, 6-6-50	75 gals...	12	10	236	+27.0	+12 90

* Owing to the fact that this plot lay in a dead furrow, an interpolated yield of 233 bushels was assigned to it in comparing its yield with that of the adjacent plots.

the control plot, where the plants died at least three or four weeks earlier than did the dusted vines, due to late blight combined with injuries from tipburn and flea beetles. Only a light and scattered infection was present at any time in the treated plots, but it was more general in the soda-bordeaux plots than in the others. Injury from flea beetles and tipburn was the most severe in the control plot, and the least severe in the lime-bordeaux plot. There was little difference, however, in the degree of injury on the vines in the lime-bordeaux plot and on the dusted vines. The foliage sprayed with soda-bordeaux showed considerable flea-beetle injury and tipburn, and died a few days earlier than did the plants in the other treated plots. Aphids were not abundant in this field. Only a trace of rotted tubers was found in any of the plots

The appearance of the foliage was very much the same in the dusted plots and in those sprayed with lime-bordeaux, but was less vigorous and less free from injury in the soda-bordeaux plots. The coating of dust on the vines dusted with Sanders' copper-lime mixture remained on the foliage longer than did the bordeaux-lead covering, and controlled the flea beetles and the tipburn more effectively. Contrary to the opinion of Lutman (1916), who pronounced bordeaux powders entirely worthless as fungicides, this bordeaux-lead preparation proved almost as effective as the lime-bordeaux spray and the copper-lime dust. The Colorado

potato beetle was equally well controlled with calcium arsenate in Sanders' dust, and lead arsenate in the sprays and in the bordeaux-lead dust. All of the tubers in each plot were dug and weighed.

An increase in the yield over that of the check, due to the different fungicides, was very apparent, even though there was no uniform repetition of the series of treatments. As can be seen from the data in table 14, the soda-bordeaux plots adjacent to the check outyielded the check more than twofold, and those protected with copper-lime dust and lime-bordeaux with the same number of applications produced a marked increase in yield over the corresponding plots sprayed with soda-bordeaux. The acre yield of plots receiving the bordeaux-lead treatment was about 21 bushels less than that for the copper-lime dust. In general the differences in yield of the treated plots corresponded closely with the relative appearance and behavior of the vines during the growing season.

Experiment 2 (Farm of H. S. Ludlow, Bridgehampton, New York).— The second experiment was conducted in a field of Irish Cobbler potatoes less than a mile from the farm where the first experiment was located. The sprayer used was a Brown machine carrying seven nozzles, one to a row.

Early blight became severe in the untreated plot, but developed only slightly on the protected vines. Mere traces of late blight were present on the dusted and on the sprayed foliage, and the infection on the unprotected rows was light as compared with that in the check in experiment 1. Both tipburn and flea-beetle injury were almost absent on the dusted foliage, were very pronounced in the sprayed plot, and were severe in the check. In this test a greater share of the injury to the control vines was not due to late blight, as in experiments 1 and 3, but to the other causes mentioned. A type of leaf injury was observed in the soda-bordeaux plots that was not present in the others, and was attributed to the spray material itself.

From the time when foliage injury became apparent in the sprayed and the untreated plot until the death of the plants in the latter, the vines in the dusted plot appeared larger and healthier. The dusted plants outlived the sprayed vines by at least a week, and those in the control by two or three weeks. All of the tubers in each plot were dug and weighed.

Again the dust made a satisfactory showing, and evidences of its superiority to the soda-bordeaux, as indicated by the relative degrees of protection and by the yields given in table 15, were more marked in this experiment than in experiment 1. It should be noted, however, that considerably more copper was applied in the dust applications of this experiment than in the spray applications.

Experiment 3 (Farm of C. E. Dimon, Southampton, New York).— In the third experiment, Sanders' copper-lime dust was compared with lime-bordeaux spray on Green Mountain potatoes. The arrangement of the plots in the field, which was 25 rods in length, is shown in table 15. The sprayer was a Red Jacket traction machine carrying six nozzles, one to a row. A pressure of about 140 pounds was maintained. The first two applications included poison for the Colorado potato beetle. At digging time, the two outer rows of each plot were discarded in determining the yields.

TABLE 15. YIELD OF DUSTED AND SPRAYED POTATOES IN EXPERIMENTS 2 AND 3, 1920
(Farms of H. S. Ludlow, Bridgehampton, New York, and C. E. Dimon, Southampton, New York)

Experiment no.	Variety	Fungicides	Rate of application per acre	Number of applications	Number of rows in plots	Yield, in bushels per acre	Increase in yield over check		Percentage increase of dust over spray
							Bushels per acre	Per cent	
2	Irish Cobbler	Soda-bordeaux (6-7-50).....	50 gals...	6	20	305	34	12.5	....
		Copper-lime dust (6 per cent of copper)......	55 lbs....	5	20	365	94	34.7	19.7
		Check	. ... .	......	20	271	.. ...	......	....
3	Green Mountain	Lime-bordeaux (6-6-50)....	50 gals.	11	12	345	141	69.1	....
		Copper-lime dust (6 per cent of copper)......	55 lbs...	11	14	370	166	81.4	7.2
		Check........	....	...	12	204	.. ..	.. . .	....

Late blight developed rapidly and severely in the check, and was the principal cause of the death of the foliage fully a month before the protected plants died. The infection was pronounced at some places in the plot sprayed with lime-bordeaux, but it was decidedly less severe in the dusted rows. A trace of tuber rot was found in the check plot only. Flea beetles and tipburn, although decidedly more injurious to the untreated vines than to those treated, were not a serious factor in this experiment. The dusted plants showed less injury from any of the sources mentioned than did those sprayed with lime-bordeaux, and remained green a few days longer. Considering the protection of the fungicides on the foliage, and the final yields (table 15), entirely satisfactory results were obtained in this experiment with the new dust. Both the dust and the spray gave a large increase in yield over the check.

Summary of results for 1920.— It is apparent, from the results of these three experiments, that both the copper-lime dust and the "bordeaux-lead" powder, when applied to wet foliage, were effective against late blight, flea beetles, and tipburn, and the increase in yield over the checks was about the same in the case of lime-bordeaux and of Sanders' dust. Soda-bordeaux furnished the least protection and produced noticeable injury.

Experiments of 1921

In Suffolk County

In 1921 the experiments for comparing copper-lime dust and bordeaux mixture in Suffolk County were conducted in duplicate, one at Bridgehampton and the other at Southampton. Green Mountain potatoes were used for the tests. There were six replications each, of the dusted, sprayed, and control plots. The arrangement of the plots in the field is shown in table 16. The sprayed plots contained six rows each, and the dusted and control plots four rows each. In experiment 1, at Southampton, the plots were 26 rods in length, and those in experiment 2, at Bridgehampton, were 24 rods in length. The copper-lime dust, that year, was mixed on the farm in a Hunter's Lightning Sifter-Mixer. It contained 6 per cent

TABLE 16. YIELD OF GREEN MOUNTAIN POTATOES DUSTED WITH COPPER-LIME DUST AND SPRAYED WITH BORDEAUX MIXTURE, SUFFOLK COUNTY

(Farms of C. E. Dimon, Southampton, New York, and H. T. Fahy, Bridgehampton, New York)

Treatment	Yield, in bushels per acre	
	Experiment 1	Experiment 2
Dusted	268.2	212.0
Sprayed	238.5	257.0
Check	226.8	169.8
Dusted	256.6	220.8
Sprayed	238.0	237.8
Check	198.0	158 0
Dusted	239.4	216.4
Sprayed	241 7	243.0
Check	217.0	200.0
Dusted	263.8	211.2
Sprayed	270 0	225.6
Check	208 8	157.2
Dusted	250.0	177.6
Sprayed	248 0	235.8
Check	229 0	179.2
Dusted	263 0	199.6
Sprayed	239.5	218 5
Check	243.0	171.0

Experiment 1: Average increase or decrease in yield:

Spray over check = $+25.53 \pm 5.83$
Dust over check = $+35.80 \pm 2.85$
Spray below dust = -10.95 ± 3.84

Experiment 2: Average increase in yield:

Spray over check = $+63.27 \pm 5.60$
Dust over check = $+32.34 \pm 5.17$
Spray over dust = $+32.30 \pm 3.84$

of metallic copper. The rate of application per acre varied from 35 pounds at the beginning of the season, to 60 pounds later when the vines were large and when conditions favorable for late blight existed. The dust was applied at the same rate on both farms—an average of 53 pounds, or the equivalent of 3.18 pounds of copper, per acre for each application.

The bordeaux formula varied from a 5–5–50 to a 7–7–50 mixture, to equal in copper content that of the corresponding dust application. In experiment 1 the average for the season was 3.2 pounds of copper per acre for each application, and in experiment 2 it was 3.07 pounds per acre. All dust applications were made in the early morning while the vines were moist, and the spray applications were made later in the same day after the foliage had dried.

The sprayer used in experiment 1 was a Red Jacket traction machine with six nozzles, one to a row, and carrying from 175 to 200 pounds pressure. Because the machine was fitted with only one nozzle to a row, it was necessary to make a double application each time the plots were sprayed, in order that the amount of copper equivalent to that in the

corresponding dust application would be applied. In experiment 2 an Iron Age traction sprayer was used, carrying twelve nozzles, two to a row, and maintaining a pressure of from 175 to 200 pounds. The duster on each farm was the Niagara power potato duster, equipped for dusting four rows with two nozzles to a row. While this machine was the best that could be obtained at that time, it was not so good as the more recent models. Although metal extensions were attached to the nozzles to protect them from the wet foliage and to aid in the distribution of the dust, and the speed of the fan was increased considerably, yet the machine failed to make as good an application of dust as is possible with a good hand duster. Not only were there unequal amounts of material delivered to the different rows, but the distribution of dust from the individual nozzles was by no means perfect. In order to offset as much as possible the uneven distribution of dust from the four sets of nozzles, the plots were dusted from opposite directions in successive applications. The machine was probably equal to, or better than, the average duster in use at that time.

Twelve applications of both the spray and the dust were made in experiment 1, and eleven applications in experiment 2. On the day of each application, the duster was driven through the check plots in order to equalize any mechanical injury to the vines. At harvest time the two middle rows of each plot were dug and weighed separately.

Late blight, although not so severe as in 1920, was destructive in all of the check plots. The infection was considerably heavier in experiment 1 than in experiment 2. The last two control plots listed in table 16 under experiment 1, suffered less from this disease than did the other four control plots. Only a light infection developed in the dusted and the sprayed plots in either experiment. The spray was slightly more effective in controlling the disease than was the dust. Tuber rot in the treated plots of experiment 2 varied from 1 to 2 per cent, but was less in the check plots due to the fact that the plants in these plots died before conditions conducive to tuber infection appeared. Only a trace of rotted tubers was found in experiment 1.

During the first half of the growing season, a severe infestation of aphids developed in both experiments. The degree of injury was practically the same in all of the treated plots, but was greater in the check plots. Flea-beetle infestation and tipburn were severe during the entire latter half of the growing season. They were more destructive in experiment 2 than in experiment 1. In both fields, however, the untreated plants suffered the most and the sprayed vines the least.

In each experiment the unprotected rows died from late blight, insect injuries, and tipburn, about three weeks earlier than the dusted plots. In experiment 2 the sprayed vines remained green for three or four days longer than the dusted plants. In both fields the bordeaux coating appeared heavier, and more uniform and permanent, on the sprayed plants than on the dusted ones.

In experiment 1, the sprayed plots yielded, on the average, less than the dusted plots by an apparently significant difference[16] (table 16), and in

[16] In calculating the increase in yield of one treatment over another—of sprayed plots over dusted plots for example—it was the practice throughout all of the field experiments where there were two or more replications, to compare the yield of each dusted plot with an interpolated yield between the two nearest sprayed plots. The differences were then averaged, and the probable error was computed as described in footnote 6, page 10.

experiment 2 they produced a significant gain over the dusted plots. The fact that the sprayed vines in experiment 1 received twice the mechanical injury that those in experiment 2 received, accounts undoubtedly in part for the relatively low yield of the sprayed plots in experiment 1 as compared with the yield of the adjacent dusted plots and checks. Furthermore, since the injuries caused by insects and tipburn were more evident in experiment 2, and since the better of the two spray machines was used in that field, the checks and the dusted plots suffered relatively more, in comparison with the accompanying sprayed plots, than did the corresponding plots in experiment 1. These conditions may help to account for the relatively low yield of the sprayed vines in experiment 1, and of the dusted plots in experiment 2 (table 16).

An interesting fact was observed regarding the effect of the fungicides on the size of the plants. In the preliminary experiments of 1920, the dusted vines appeared larger and thriftier than the plants sprayed with soda-bordeaux or those in the check plots, but they were practically of the same size as the vines sprayed with lime-bordeaux. In 1921 horse-drawn machinery was used in both the dusted and the sprayed plots, and the duster was driven through the control plots each time that an application was made on the other plots. During the period from the first to the third application, there appeared to be no appreciable difference in the size and appearance of the plants in the different plots. During the following two weeks, however, the vines in the check plots looked decidedly higher and more vigorous than those in the adjacent dusted and sprayed plots. This condition remained noticeable until the unprotected vines began to die from diseases and insects.

In these experiments the copper-lime dust did not compare so favorably with lime-bordeaux, in the protection of potato foliage against diseases and insects, as it did in 1920. It should be remembered, however, that in experiment 2 of 1921, in which the sprayed plots outyielded the dusted plots by a significant margin, the spraying was done more thoroughly than in 1920, and the distribution of dust to the foliage from the crude power machines was not so thorough as that obtained with the hand duster in the preceding year. Although the sprayed plants in experiment 1 remained green as long as the dusted vines and sustained less injury from flea beetles and blight, yet the dusted plots produced an apparently significant increase in yield over the sprayed plots (table 16), due, no doubt, to the greater vine injury produced during the double applications of the spray. As can be seen from the data in table 16, the treated plots in both experiments produced marked increases in yield over the control plots.

In Washington County[17]

The experiments in Washington County were conducted in the fields of farmers who grow mainly American Giant potatoes. Only a small proportion of the growers had been spraying regularly for late blight, due chiefly to the inconveniences experienced in handling spray machines in a hilly country. As a result, in certain years heavy losses were sustained from insect injury and late blight.

[17] The experiments conducted in Washington County, although planned by and carried out under the general direction of the writer, were under the direct supervision of F. Dickson, at that time a graduate student in the Department of Plant Pathology at Cornell University, who personally supervised the spraying and did most of the dusting.

The dust mixture for the first application in each experiment was Sanders' copper-lime-arsenic dust, containing 5 per cent of copper and applied at the rate of 34 pounds per acre. In the second application, the same dust was applied at the rate of 60 pounds per acre. For the remaining applications, a dust containing 6 per cent of copper was applied at the rate of 50 pounds per acre. The spray for the first application was a 4–4–50 bordeaux mixture, and that for the remaining applications a 6–6–50 mixture, each applied at the rate of 100 gallons per acre. Hence, in all of the experiments, approximately equivalent amounts of copper were used in the two fungicides at each application.

For the control of the Colorado potato beetle in the check plots in all of the experiments, a dust mixture containing paris green and hydrated lime was used. The growers' own sprayers were employed in the experimental plots, and the formula of the bordeaux mixture was varied so as to equal in copper content that of the corresponding dust application.

Experiment 1 (Farm of F. McEachron, Salem, New York).—An experiment was conducted on the McEachron farm to compare the merits of several kinds of machines and to compare the copper-lime dust with the bordeaux mixture. The field was 21 rods in length, and was planted in checked rows. The following machines were used in the test: (1) A Eureka traction sprayer with eight nozzles, two to a row, and carrying a pressure of from 100 to 150 pounds; (2) a Niagara 1921-model engine-power potato duster, with eight nozzles, two to a row; (3) a Johnson traction potato duster with four nozzles, one to a row; (4) an Ideal Cotton duster, a one-wheel traction machine with two nozzles, one to a row; (5) a Leggett hand duster with one nozzle. The hand duster was operated up one side of the row and down the opposite side, to give a two-nozzle-to-a-row effect. All dust applications were made in the morning while the dew was on the vines, and spray applications were made later in the day when the vines were dry. Eight applications were made between June 20 and September 7.

The number of replications for each treatment was six. However, due to the fact that toward the end of the season the last two replications on one side of the experiment were washed out during a heavy rainstorm, only four of the plots for each treatment were dug. The arrangement of plots in the experiment is shown in table 17. At harvest time the two middle rows of the four-row plots were dug and weighed, and one row from the one-row and the two-row plots. In computing the yields under the different treatments, the last two plots shown in the table were not taken into account due to the fact that they also were partly washed out.

Unfortunately, since no early or late blight developed in the experiments, no comparison could be made as to the fungicidal value of the materials. The dust containing calcium arsenate controlled the Colorado potato beetle as effectively as did the paris green in the bordeaux mixture. Flea beetles and leaf hoppers were present in large numbers, and were decidedly more destructive on the untreated than on the protected vines. Also, tipburn was more severe on the checks, and was the cause of most of the injury which caused premature death of the vines in that plot. The sprayed plots showed the least amount of injury from these sources, and the plants dusted by hand showed only slightly more. Practically no difference could be detected in the degree of injury in the other treated plots. The vines that were dusted with the three horse-drawn machines

TABLE 17. YIELD OF AMERICAN GIANT POTATOES SPRAYED WITH BORDEAUX MIXTURE AND DUSTED WITH COPPER-LIME DUST, USING FOUR TYPES OF DUSTERS

(Farm of Foster McEachron, Salem, New York)

Machine used	Number of rows in plots	Number of rows dug	Yield, in bushels per acre			
			Series I	Series II	Series III	Series IV
Check	4	2	217.8	256.8	243.2	227.2
Ideal Cotton duster; 2-row, traction	2	1	235.2	272.8	249.6	245.6
Leggett hand duster	1	1	264.4	296.8	264.8	276.8
Eureka sprayer; 4-row, traction	4	2	268.0	278.0	252.8	266.0
Johnson duster; 4-row, traction	4	2	253.0	282.0	246.0	240.4*
Niagara duster; 4-row, engine power	4	2	261.2	280.0	251.2	214.0*

Average increase or decrease in yield:

Hand duster over check	=	+38.65 ± 0.98
Niagara duster over check	=	+20.08 ± 4.56
Sprayer over Niagara duster	=	+ 1.83 ± 4.90
Sprayer below hand duster	=	− 9.45 ± 3.30
Ideal Cotton duster over check	=	+14.55 ± 1.82
Hand duster over Ideal Cotton duster	=	+25.00 ± 2.25
Johnson duster over check	=	+16.47 ± 3.57
Sprayer over Johnson duster	=	+ 5.80 ± 5.30
Sprayer over Ideal Cotton duster	=	+15.52 ± 4.37

* Due to the fact that these plots were partly washed away, the yields were not considered in calculating the averages.

remained green about two weeks longer than the vines in the check plots, and those protected with the sprayer and the hand duster remained green three or four days longer than those dusted with the horse-drawn machines.

Regarding the relative efficiency of the machines in distributing the material on the vines, the sprayed plants showed a thicker coating of material than did those that were dusted by hand, and both presented a uniform covering on the upper side of the foliage. The dust coating on the foliage of the other plots was neither so heavy nor so uniformly distributed. The vines dusted with the power machine carrying two nozzles to a row were more thoroughly covered than those dusted with the traction machines with one nozzle to a row.

In general the yields of the plots under the different treatments corresponded closely with the respective degrees of protection against tipburn, hopper burn, and flea beetles (table 17). The hand-dusted plot, however, produced an apparently significant increase in yield over the sprayed plots, even though the sprayed plots showed less injury from disease and insects. Undoubtedly there was an injurious effect caused by the machines and horses passing through the plots. Significant increases in yield over the untreated plots were obtained with each of the treatments, and that obtained by the use of the hand duster was higher than that for the sprayer and that for the best of the horse-drawn dusters. A marked

increase in yield was obtained with the hand duster over the Ideal Cotton duster, but there was no significant difference between the yields with the Niagara duster and with the sprayer.

Experiment 2 (Farm of Henry F. Reid, Belcher, New York).—On the Reid farm, Sanders' copper-lime dust, applied with a hand duster, was compared with bordeaux mixture applied with a four-row Iron Age traction machine, equipped with two nozzles to a row and carrying a pressure of from 150 to 200 pounds. The field was 50 rods in length. There were four sprayed plots containing four rows each, four dusted plots with three rows each, and two untreated plots with four rows each. The arrangement of the plots in the experiment is shown in table 18. At digging time

TABLE 18. YIELD OF AMERICAN GIANT POTATOES SPRAYED WITH BORDEAUX MIXTURE AND DUSTED WITH COPPER-LIME DUST, 1921

(Farm of Henry F. Reid, Belcher, New York)

Treatment	Number of rows in plots	Number of rows dug	Yield, in bushels per acre	
			Series I	Series II
Sprayed	4	2	255.2	323.7
Dusted	3	1	303.5	346.1
Sprayed	4	2	292.8	318.9
Dusted	3	1	299.2	285.5
Check	4	2	229.6	277.3

Average increase or decrease in yield:
Dust over check = +45.80 ± 25.30
Spray below dust = − 4.32 ± 9.80

the two middle rows of each four-row plot, and the middle row of each three-row plot, were dug and weighed. There were eight applications of fungicide between July 6 and September 13.

No fungous diseases developed in the plots. Tipburn was severe on the unprotected plots, and caused the greater part of the injury to the foliage. Practically no tipburn injury was observed on the treated vines. The Colorado potato beetles were effectively controlled in the first two applications by the calcium arsenate in the dust and by the paris green in the bordeaux mixture. Injury from flea beetles and leaf hoppers, while not severe on either the dusted or the sprayed plots, was more noticeable on the dusted foliage and was decidedly more severe on the control plots. The dusted and the sprayed vines remained green about two weeks longer than did the vines on the check plots. The dusted plots produced a marked increase in yield over the control plots (table 18), but, due to the smaller number of check plots in this experiment, the difference of 45.8 bushels between the average for the checks and that for the dusted plots did not prove significant. It was observed throughout the season that the sprayed vines sustained slightly less injury from tipburn and insects than did the dusted plants, but the latter yielded as much as the former. Here again it appears that the plots treated with the horse-drawn machine might have

suffered a handicap in the way of greater mechanical injury either to the roots or to the tops, or to both.

Experiment 3 (Farm of Nelson Pratt, Cossayuna, New York).—In the third experiment, plots dusted with a copper-lime dust were compared with untreated plots. The machinery included the Leggett hand duster, and a Johnson traction duster equipped with four nozzles, one to a row. The field was 15 rods in length and was planted in checked rows. The checks contained four rows each, the hand-dusted plots one row, and the plots dusted with the traction machine eight rows each. The first two applications included poison for the Colorado potato beetle. Seven applications of dust were made between July 1 and September 12. At harvest time each hand-dusted row, and the two middle rows in each of the other plots, were dug and weighed

No fungous diseases were present. Tipburn, however, was severe in the control plots and was practically absent in the dusted rows. Calcium arsenate in the copper-lime dust controlled the Colorado potato beetle practically as effectively as did the paris green in the checks. Toward the end of August, there developed a second but light infestation of these beetles. The beetles avoided the dusted vines almost entirely, and fed only on the unprotected plants. Flea beetles and leaf hoppers were numerous on the check plots, but produced only slight injury on the dusted plants. During the latter part of the season, a light infestation of aphids developed with equal severity in all of the plots.

The vines dusted by hand were more uniformly covered than were those in the plots dusted with the traction machine. Although very little difference could be noted in the degree of injury on the foliage dusted with the two machines, yet it is seen from the data in table 19 that the hand-

TABLE 19. YIELD OF AMERICAN GIANT POTATOES DUSTED WITH COPPER-LIME DUST, USING A TRACTION MACHINE AND A HAND DUSTER, 1921

(Farm of Nelson Pratt, Cossayuna, New York)

Duster used	Number of rows in plots	Number of rows dug	Yield, in bushels per acre					
			Series I	Series II	Series III	Series IV	Series V	Series VI
Traction duster, 4-row	8	2	255.5	307.2	312.0	264.5	248.5	248.5
Hand duster	1	1	317.8	321.3	268.8	309.3	290.1	275.2
Check	4	2	293.9	286.9	266.1	284.8	205.3	272.0

Average increase in yield:
Hand duster over check = 27.71 ± 7.75
Hand duster over traction machine = 24.50 ± 9.43

dusted plots produced a significant increase in yield over the checks, while the plots dusted with the horse-drawn machine did not. This difference in yield obtained under the two treatments can probably be attributed to the same factor mentioned in connection with experiments 1 and 2 — that is, to the greater mechanical injury produced by the horses and the wheels.

Experiment 4 (Farm of William Morgan, West Hebron, New York).—A field of American Giant potatoes was under experiment on the Morgan farm. The field was 32 rods in length. The arrangement of the plots is shown in table 20. The copper-lime dust was applied with a hand duster, and the bordeaux mixture was applied with a Eureka traction sprayer

TABLE 20. YIELD OF AMERICAN GIANT POTATOES SPRAYED WITH BORDEAUX MIXTURE AND DUSTED WITH COPPER-LIME DUST, 1921

(Farm of William Morgan, West Hebron, New York)

Treatment	Number of rows in plots	Number of rows dug	Yield, in bushels per acre			
			Series I	Series II	Series III	Series IV
Sprayed	4	2	139.5	144.7	138.1	141.4
Dusted	3	1	168 5	157.3	160.1	163.3
Check	4	2	165.7	161.9	154 9	158.7

Average increase or decrease in yield:

Dust over check = + 2.50 ± 0 80

Spray below check = −18.15 ± 1.56

Spray below dust = −21.54 ± 2.06

carrying eight nozzles, two to a row. Eight applications of both fungicides were made between July 5 and September 14 In determining the yields, the middle rows of the plots were dug and weighed.

Fungous diseases were absent. Leaf hoppers and flea beetles were injurious on the checks, but not so destructive as the tipburn resulting from the hot, dry weather. Injury from these sources was decidedly less severe on the treated vines, the sprayed foliage escaping with slightly less injury than the dusted vines. The plants in the checks died from ten days to two weeks earlier than the plants in the protected plots. Practically no difference was noted between the length of the growing period of the dusted and the sprayed plants.

It will be noted from the data in table 20, that, contrary to the results obtained in the three preceding experiments, the sprayed plots yielded less by a marked difference than did the control plots. Although the dusted plots yielded, on the average, only 2.5 bushels more than did the check plots, the difference appears to be significant. The dusted plants also produced a considerable increase in yield, 21.54 bushels, over the sprayed plots.

This section of the county was particularly hot and dry, and consequently the conditions for growth were unfavorable. The yield for the entire field was low. Judging from the results of exper ments 1, 2, and 3, in which there occurred an apparent reduction in yield where horse-drawn duste s or sprayers were employed, the results of experiment 4 are not surprising because the injury that was inflicted on the plants by the spraying was not overcome by the beneficial effects of the materials, due to the unfavorable growing season. Since the degree of this mechanical injury was by no means so great in the plots dusted by hand, or in the check

plots which received two applications of paris-green dust applied with the hand duster, there resulted a proportionately higher beneficia effect from the dusting than from the spraying.

Experiment 5 (Farm of J. Crowley, Hudson Falls, New York).—The fifth experiment was conducted in a field of Peerless potatoes, which was located in the low muck lands of a region known as Dunham's Basin. Six e ght-row dusted plots alternated with four-row check plots. The field was 30 rods in length, and was planted in checked rows. Six applications of dust were made between July 9 and August 30. The duster used on this farm was a four-row Johnson traction machine with one nozzle to a row. At harvest time the two middle rows of the check plots, and the four middle rows of the dusted plots, were dug and weighed (table 21).

TABLE 21. YIELD OF PEERLESS POTATOES DUSTED WITH COPPER-LIME DUST, 1921
(Farm of J. Crowley, Hudson Falls, New York)

Treatment	Number of rows in plots	Number of rows dug	Yield, in bushels per acre						
			Series I	Series II	Series III	Series IV	Series V	Series VI	Series VII
Dusted...	8	4	115.2	129.7	133.7	132.3	127.3	135.0	.....
Check....	4	2	128.2	131.7	147.0	140.4	165.4*	153.0	140.1

Average increase in yield of checks over dusted plots = 13.26 ± 1.35 bushels

* Due to the fact that this plot lay in a dead furrow and yielded abnormally high, the yields of the two nearest dusted plots were compared with the other adjacent controls.

The entire field, including the area under experiment, was a level bed of black muck. During the early part of the season, the plants made a vigorous growth. The weather, however, turned hot and dry, and remained so during most of the time until September. Injury to the tops from tipburn, flea beetles, and leaf hoppers was only slight, even in the check plots. During the drought in August, the muck became intensely hot, and the lower leaves of the plants began to turn yellow and die. During the last week of that month the entire field, the dusted and the check plants alike, died more or less suddenly as if they had been killed by the hot, dry soil. The foliage did not exhibit the typical symptoms of tipburn or hopper-burn. The yield over the entire field was low, due to the premature death of the vines. Furthermore, there was a significant decrease in yield of the dusted plants below the control plants, due apparently to mechanical injury from driving through the plots with the duster. Had there been hand-dusted plots in the experiment, in all probability they would probably have yielded about the same as did the control plots.

Summary of results in Washington County, 1921.—In comparing Sanders' copper-lime dust with bordeaux spray for the control of foliage injury caused by tipburn, flea beetles, and leaf hoppers, the bordeaux mixture proved slightly superior to the dust, even when the dust was applied evenly to the foliage with a hand duster. Both the spray and the dust

furnished a high degree of control. On the other hand, by comparing the yields of plots dusted with the hand duster and those sprayed with a traction sprayer, the dusted vines yielded as much as, or more than, the sprayed plants. Also, the hand-dusted plots, as a rule, yielded higher than did the plots dusted with traction or power machines. In experiment 5, in which only a traction duster was used and in which the entire field died prematurely, due apparently to the abnormally high soil temperature which killed the treated and the untreated plants alike, the check plots yielded more tubers, by a significant figure, than did the dusted rows. In general, the results on comparative yields indicate strongly that there was a certain amount of injury inflicted to the plants by the horses and the machines. This sort of injury would probably be only slight in a hand-dusted plot. The nature of the growing season, in all probability, determines whether or not this injurious effect will be overcome through the protective action of the fungicide on the foliage. If the season is favorable for normal growth, the deleterious effect will be overshadowed by the increase in yield due to the protection against diseases and insects. If the season is unfavorable for growth, the injurious effect may remain greater than any beneficial effect derived from protection.

Experiments of 1922

The experiments of 1922 for the comparison of copper-lime dust with bordeaux mixture, were located on the same farms in Suffolk County as those for 1921. The test was conducted in duplicate on Green Mountain potatoes, and there were six dusted, six sprayed, and three check plots. Each field was 24 rods long. All of the plots contained four rows each, with the exception of the sprayed plots in experiment 2, which contained six rows. The dusts were mixed on the farm, in a mixer operated by gas-engine power.

For beetle control, calcium arsenate was added to the dust mixture for the first two applications in each experiment. Lead-arsenate was included in the corresponding spray applications. Thirteen applications were made in experiment 1 between June 10 and August 19, and fourteen in experiment 2 between June 12 and August 16. The dust applications were made in the morning while the dew was on the foliage, and the spray applications were made later in the same day on the dry vines.

The copper-lime dusts used during the season contained, respectively, 8.5 per cent and 10 per cent of copper. In experiment 1, located on the farm of C. E. Dimon, Southampton, New York, the dust containing 10 per cent of copper was employed in the first to the seventh applications, and in the twelfth and thirteenth. The 8.5-per-cent-copper mixture was used in the other applications. In experiment 2, located on the farm of H. T. Fahy, Bridgehampton, New York, the mixture with 10 per cent of copper was applied in the first to the eighth applications and in the thirteenth and fourteenth, and the 8.5-per-cent dust in the remaining ones. It was the intention to apply about 3 pounds of copper per acre at each application. The average for all of the applications was 3.73 pounds in experiment 1, and 4.26 pounds in experiment 2, at each application. The spray mixture was the same in both experiments—a 6–4–50 preparation, or a formula with that ratio of copper sulfate to lime—but it varied upward

or downward in copper content to equal that of the dust application of the same day. The rate of application was 100 gallons per acre, and the average quantity of copper applied per acre at each application throughout the season was 3.88 pounds for experiment 1 and 3.5 pounds for experiment 2.

The duster was driven through the control plots each time that the adjacent dusted and sprayed plots received an application. By observing this practice as long as there was foliage on the checks, any injury to the plants from the wheels or the horses would be equalized in all plots. At digging time, the two middle rows of each plot were dug and the rows were divided into two portions of equal lengths. The tubers in each end were then collected separately and weighed.

The dusting and spraying machinery used in 1922 was superior to that used in the preceding year. In experiment 1, during the first half of the season a Brown sprayer with two double-action cylinders was employed. A 30-gallon air-pressure reserve tank made it possible to maintain maximum pressure while the sprayer was being turned at the end of the plots. The boom was altered so that four-row plots could be sprayed, with two nozzles to a row. The nozzles of each pair were placed about 20 inches apart and were directed slightly inward as well as downward. The average pressure for the six applications made with this machine was 195 pounds, the lowest being 160 and the highest 225 pounds. No such variation in pressure, however, occurred in one day. For the remainder of the season, a 1922-model Yellow Jacket sprayer was employed. The boom of this machine, also, was altered for spraying four-row plots, with two nozzles to a row. Although the reserve air tank on the Yellow Jacket was smaller, this machine proved, on the whole, much more reliable in applying the spray at a uniformly high pressure. An average of 225 pounds was maintained during the remaining seven applications, the lowest pressure being 220 pounds and the highest 270 pounds.

The spraying machines for experiment 2 were not so efficient as those used in experiment 1. The first two applications were made with an Iron Age sprayer that had been operated previously through one or two seasons. It carried twelve nozzles, two to a row, and maintained a pressure of only about 145 pounds. During the remainder of the season, a new Red Jacket machine was available. This machine was fitted with a boom for spraying six rows, with two nozzles to a row. A uniform pressure of from 200 to 210 pounds was maintained.

The duster used in experiment 1 was the 1922-model Niagara F–22–P power potato duster equipped with a 5-horse-power Pierson engine. This duster proved to be in many respects a decided improvement over the 1921-model machine, particularly in the increase in size and speed of the fan, with a resulting increase in air pressure. The distributing system, with larger nozzles and a greater diameter of pipes, also was found to be more efficient than the type on the duster of the preceding year. Due to the fact that the hopper and the fan case were constructed of aluminum, and the main axle turned in long roller-bearings, the weight and the draft were decreased considerably.

Although the machine represented one of the best on the market available for potato dusting, yet there were several faulty features that could not then be entirely remedied. One of these was the failure of the nozzles

to spread the dust out sufficiently to envelop the plants completely and give an even distribution of material to the individual row, in spite of the fact that a blast of air sufficiently strong to blow the dust out forcibly could be created. Another fault was the uneven flow of air and dust from the main pipe into the four large distributing pipes. The result was an uneven delivery of dust to the different rows, in fact a uniform decrease from one outer pair of nozzles to the opposite outer pair. The third fault consisted in an occasional side delivery of dust and wind from one or more of the nozzles, resulting in an uneven application or a streaking effect on the row. The first and third sources of trouble were to a large extent corrected at the ouset of the experiment, but the cause of the second fault was not ascertained until the dusting season was half over. Until that time, the machine was driven through the plots in opposite directions during successive applications, in order to equalize as far as possible the amount of dust applied to the different rows. To overcome the effect of strong winds, an apron was constructed and so attached to the boom that it hung over and behind the nozzles. This apron also protected the nozzles from side winds.

In experiment 2 the same machine that was operated during the preceding season, the 1921-model Niagara power potato duster, was employed again in 1922. The distributing pipes and nozzles, however, were replaced by those for the 1922 model. While fairly uniform amounts of dust were delivered from the four pairs of nozzles, the same difficulties as to the manner of dust delivery from the individual outlets were experienced with this duster as were mentioned in connection with the 1922 machine. Furthermore, owing to the fact that the speed of the engine was difficult to regulate at times, during several applications the amount of dust fed from the hopper was so light that it was necessary to drive through the plots twice in order to apply sufficient fungicide.

Both early blight and late blight were present in 1922. In both experiments, late-blight infection was severe in the check plots and caused the greater part of the premature death of the foliage. While it was present in the treated rows as a light infection, it occasioned only a very small loss of foliage, and was no more evident in the dusted plots than in the sprayed plots. As a whole, the degree of infection was slightly heavier in experiment 2 than in experiment 1. Early blight did not become serious in either experiment, but it was more difficult to control than late blight. A more or less uniform infection was present in both the dusted and the sprayed rows during the greater part of the season. The injury to the untreated plants, however, was greater than that suffered by the treated plants.

Injury from flea beetles was slightly heavier in the dusted plots, in both experiments, than in the sprayed plots. In either case the degree of injury was very slight as compared with that on the unprotected vines. Tipburn was not an important factor that season, but was more noticeable on the check plants than on the dusted or the sprayed foliage. Aphids, while represented by a fairly heavy infestation of about a week's duration, occasioned no serious damage, and were more or less equally distributed in the treated and the check plots. No leaf hoppers were observed.

During practically the entire season the sprayed plants appeared to have a heavier coating of copper on the leaves, especially on their upper

side, than did the dusted vines. The dusted plants, on the other hand, showed more copper on such parts as stalks, branches, and the under side of leaflets, than did those sprayed with bordeaux mixture. This feature was particularly noticeable in the experiments on the relative adhesiveness of the dust and the spray mixtures, in which observations and tests for copper were made on plots dusted carefully with a good hand machine.

The difference in the rate of vine growth in the protected and the unprotected plots was more marked in 1922 than in 1921. There was no apparent difference in the size and the appearance of the dusted and the sprayed vines; the check plants, however, in both experiments grew for a time more rapidly than did the treated vines, resulting in a greater height and a greater spread of tops. This difference was first noticed between the third and the fourth application, and it continued to increase for at least three weeks, or until the foliage of the checks began to show excessive injury from flea beetles, late blight, and tipburn. After a greater part of the leaves had been stripped from the check vines, the stalks towered above the plants in the adjacent plots that had received copper. The copper-lime dust containing 10 per cent of copper, which was used during the first part of the season, appeared to produce a slight burning of the foliage, but the injury was not considered severe enough to account for any dwarfing effect in the growth of the plant as a whole. Furthermore, the sprayed vines on which no copper injury was apparent exhibited the same stunted effect. Since the check plots received a corresponding amount of injury from horses and wheels to that received by the dusted and the sprayed plots, it seems probable that the apparent injurious effect may have been due to the presence of the copper coatings.

In experiment 1, the dusted vines were as green and as healthy in appearance, and remained green as long, as those in the sprayed plots. The foliage of the checks was dead by August 2, while that of the treated plots did not die until August 28. In experiment 2, the dusted vines, during the latter half of the spraying season, showed the effect of the mechanical injury inflicted on them by the double applications of the fungicide. In six applications, the duster was driven through the plots twice. The sprayed plants lived a few days longer than did the dusted plants, but the dusted plants remained green three weeks longer than did the check plants.

Concerning the yields of the plots under different treatments, in experiment 1, in which the dusted and the sprayed plants exhibited more or less equal degrees of protection against diseases and insects, and in which the amount of injury due to horses and to machines was the same under the two treatments, the yields were approximately the same (table 22). The average difference, while only a little less than four bushels per acre, might be considered a significant decrease for the spray below the dust. In experiment 2, in which conditions were practically identical with those in the first experiment aside from the double applications of dust that were made on six different occasions, the sprayed plots produced a significant increase in yield over the dusted plots. In both experiments, notable increases in yield were obtained in the treated plots over the control plots.

Summary of results for 1922.— The results for 1922 in Suffolk County indicate that, during a season when early blight, late blight, and flea beetles were important factors in the experiments, copper-lime dust applied

TABLE 22. YIELD OF GREEN MOUNTAIN POTATOES DUSTED WITH COPPER-LIME DUST AND SPRAYED WITH BORDEAUX MIXTURE, 1922

(Farms of C. E. Dimon, Southampton, New York, and H. T. Fahy, Bridgehampton, New York)

Treatment	Yield, in bushels per acre			
	Experiment 1		Experiment 2	
	North end	South end	North end	South end
Dusted	378.8	384.7	263.9	278.7
Sprayed	372.0	378.7	334.5	319.8
Check	305.4	314.7	236.4	230.1
Dusted	374.7	396.0	288.0	288.8
Sprayed	383.3	397.4	317.1	318.2
Dusted	410.4	397.3	305.4	313.5
Sprayed	412.8	420.1	327.8	341.9
Check	314.8	335.3	263.1	246.5
Dusted	411.2	422.7	298.8	310.8
Sprayed	400.4	414.0	326.9	320.2
Dusted	403.9	394.0	280.0	283.6
Sprayed	385.0	371.9	323.7	326.8
Check	290.0	298.7	233.2	212.2
Dusted	387.3	395.4	285.8	258.9
Sprayed	387.9	395.3	327.1	319.7

Experiment 1: Average increase or decrease in yield:

Spray below dust .... = -3.98 ± 1.38

Dust over check .... = $+87.07 \pm 3.56$

Experiment 2: Average increase in yield:

Spray over dust .... = $+36.97 \pm 3.35$

Dust over check .... = $+51.26 \pm 2.64$

at rates sufficiently high to give a prominent coating on the upper sides of the leaves controlled the fungous diseases as effectively as did bordeaux mixture applied at an equal rate with an exceptionally good sprayer. The bordeaux coating proved slightly superior in controlling flea beetles and tipburn. Further evidence was obtained that excessive driving through plots with a horse-drawn duster or sprayer results in additional injury to the plants, accompanied by a decrease in yield. The better duster in use in 1922 did not compare in efficiency with well-equipped traction sprayers.

Summary of results for 1920, 1921, and 1922

The results of the three years of experimentation in comparing copper-lime dust with bordeaux mixture for the control of fungous diseases and insect pests, indicate that copper-lime dusts containing 6, 8.5, and 10 per cent of copper, when applied to damp foliage, with distribution as thorough as that furnished by a good hand duster or the best of the power dusters, controlled early and late blight and aphids as effectively as did lime-bordeaux of equal copper content, and more effectively than did soda-bordeaux. In the control of flea beetles and tipburn the dusts were more effective than soda-bordeaux but slightly less effective than lime-bordeaux.

The lime-bordeaux was more effective also against the leaf hopper. Other conditions being equal, the yields were proportional to the degree of protection against fungous diseases, tipburn, and flea beetles, which were the major sources of injury. Hand-dusted plots, in general, yielded higher than did the plots that were dusted or sprayed with horse-drawn machines, due apparently to the lesser amount of injury to the plants in the rows dusted by hand. Under conditions calling for double applications of either the dust or the spray during a part or all of the season, a decided reduction in yield resulted in those plots through which the machine was driven an extra number of times, due apparently to the additional mechanical injury.

A summary of the results for the three years (table 23) shows that the sprayed plots produced, on the average, a gain over the dusted plots of

TABLE 23. SUMMARY OF DATA SHOWING DIFFERENCES IN YIELD OF POTATOES SPRAYED WITH BORDEAUX MIXTURE AND DUSTED WITH COPPER-LIME DUST, 1920, 1921, AND 1922

Year	Major sources of injury	Data from table no.	Plot no.	Increase or decrease in yield (bushels per acre), spray over or below dust: Individual*	Increase or decrease in yield (bushels per acre), spray over or below dust: Average
1920	Late blight; flea beetles	14	1	−10.50	−10.50
		15	1	−25.00	−25.00
1921	Late blight; flea beetles; tipburn	16 Experiment 1	1 2 3 4 5 6	−29 70 −18.40 + 1.00 − 3.90 + 5.80 −20.50	−10.95 ± 3.84
1921	Late blight; flea beetles	16 Experiment 2	1 2 3 4 5 6	+45.00 +23.90 +24.70 +20.60 +54 50 +25.10	+32.30 ± 3.84
1921	Flea beetles; tipburn	17 Ideal Cotton duster	1 2 3 4	+32.80 + 3.20 + 8.50 +17.60	+15.52 ± 4.37
		17 Hand duster	1 2 3 4	+ 3.60 −20.10 − 8.80 −12.50	− 9.45 ± 3.30
		17 Johnson duster	1 2 3	+17.10 − 9.30 + 9.60	+ 5.80 ± 5.30

TABLE 23 (*concluded*)

Year	Major sources of injury	Data from table no.	Plot no.	Increase or decrease in yield (bushels per acre), spray over or below dust: Individual*	Average
1921	Flea beetles; tipburn	17 Niagara duster	1	+11.00	
			2	−12 60	
			3	+ 7.10	+ 1.83 ± 4.90
		18	1	−29.50	
			2	+ 3.50	
			3	−24.90	
			4	+33.60	− 4 32 ± 9.80
		20	1	−29.00	
			2	−14.34	
			3	−19.81	
			4	−23.00	−21.54 ± 2.06
1922	Late blight; flea beetles	22 Experiment 1	1	− 6.80	
			2	+ 4.80	
			3	−12.40	
			4	− 6.70	
			5	−11.20	
			6	− 0.30	
			7	− 6 00	
			8	− 4 80	
			9	+11.40	
			10	− 6 70	
			11	− 1.10	
			12	− 7 90	− 3.98 ± 1.38
		22 Experiment 2	1	+70.60	
			2	+34.90	
			3	+17.05	
			4	+28.39	
			5	+45 30	
			6	+40.16	
			7	+41.10	
			8	+29.93	
			9	+16.55	
			10	+16.63	
			11	+39.90	
			12	+63.16	+36 97 ± 3.35
Average				+7 205 ± 2.11	

* For method of calculation used for this column, see footnote 16, page 33.

7.205 ± 2.11 bushels per acre. This difference may be considered significant, and in all probability represents, under the conditions of the experiments, the difference between the relative values of the two methods of protection.

COMPARISON OF EFFECTIVENESS OF COPPER-LIME DUST APPLIED TO WET AND TO DRY FOLIAGE

In 1922 an experiment was conducted on Green Mountain potatoes to compare the effectiveness of dusting wet and dry foliage for the control of diseases and insects. The test was located on the farm of C. E. Dimon, Southampton, New York. All of the plots were 22 rods in length and four rows in width, and were arranged in the experiment in the order shown in table 24. Thirteen applications of dust were made at intervals of from five to seven days. A dust containing 10 per cent of copper was used for nine of the applications, and one containing $8\frac{1}{2}$ per cent of copper for the other four applications. The plot dusted by hand and those dusted when wet received applications in the early morning, and those dusted when the vines were dry received applications later in the same day, usually in the early part of the afternoon. Even in the middle of the afternoon on some days the lower leaves were not entirely dry. A 1922 Niagara power potato duster and a Feeny hand duster were used. In each application, approximately equal amounts of dust were applied by the power machine to the wet and to the dry foliage. The average amount of copper applied per acre in each application was 3.8 pounds for the power machine and 3.52 pounds for the hand machine. An apron attached to the boom was used whenever a strong wind was blowing. On days when applications were made, the duster was driven through the check plot and through the plot dusted by hand in order to equalize any injury that might occur

TABLE 24. YIELD OF GREEN MOUNTAIN POTATOES DUSTED WITH COPPER-LIME DUST WHEN THE FOLIAGE WAS WET AND WHEN IT WAS DRY, 1922

(Farm of C. E. Dimon, Southampton, New York)

Condition of vines when dusted	Yield, in bushels per acre	
	North end of plot	South end of plot
Wet	388.8	406.4
Dry	404.0	408.0
Wet	388.4	392.8
Dry	373.2	383.2
Wet (hand duster)	371.2	372.0
Wet	384.8	388.4
Dry	386.0	388.8
Check	320.0	315.2
Wet	460.8	397.2
Dry	402.8	401.2
Wet	366.4	350.0
Dry	376.4	381.4
Wet	365.2	352.4
Dry	384.4	380.0

Average increase in yield:
- Plants dusted when dry over those dusted when wet...... = 9.91 ± 2.80
- Plants dusted when wet, power machine over hand duster.. = 16.33 ± 1.03
- Plants dusted when wet over check plants.............. = 76.43 ± 2.00

from the horses and from the wheels of the machine. At harvest time, the plots were divided into two equal parts and the tubers for each plot were gathered and weighed.

In the discussion on the relative adhesiveness of fungicides, it was pointed out that, under both laboratory and field conditions, more copper-lime dust was retained by wet than by dry foliage, and that proportionately less dust was washed from the vines between applications. The field experiment referred to under that topic (page 16) is the one under consideration here.

The foliage that was dusted when dry exhibited at all times a very light coating of copper. After dashing rains, little, if any, of the characteristic blue color of the bordeaux coating could be distinguished on the foliage when this was observed even at close range. The lowermost leaves showed the heaviest layer of "copper" coating, these being the ones that were sometimes damp when the applications were made. In the plots that were dusted when the foliage was wet, on the other hand, there was always present a relatively heavy, prominent copper coating. The plants of the hand-dusted plot were more evenly covered than those that were dusted with the power machine. During each application, each of the four rows of the plot dusted by hand was dusted up one side and down the opposite side, so that a two-nozzle-to-the-row effect could be obtained.

Late blight was at no time serious in any of the treated plots, but it was considerably more in evidence in the plots that were dusted when dry than in the other dusted rows. Although the plants in the control plot suffered severely from this disease during the latter part of the season, the infection in the plots dusted when dry, which gave light tests for copper, was relatively low, showing that a very light coating of the dust, if it was distributed reasonably well, was almost as effective as the heavier coating on the leaves that were dusted when wet. Early blight, and injury from tipburn and flea beetles, were decidedly more prominent in the check plot than in the plots that were dusted when the vines were wet, but only slightly more evident than in the plots that were dusted when dry. Evidently the difference in the thickness of the coating was influential in the control of the beetles and of tipburn, and the difference in the amount of copper was influential in the control of the fungous diseases. Injury from aphids was about equal in all of the plots.

Vine behavior, in the plots that were dusted when wet, was about the same with both the power duster and the hand machine. The check plot stood well above the rows that were dusted when wet, in size and spread of plants. Observations in this respect corresponded with those for the two preceding experiments (page 44). The plants in the plots that were dusted when dry, on the other hand, showed little if any dwarfing as compared with the check plot. The plots that were dusted when wet were dead on August 28, those that were dusted when dry on August 22, and the check plot on August 10.

It is interesting to note, concerning the relative yields (table 24), that even though the plants with the light coating of dust exhibited greater injury from early and late blight and from tipburn and flea beetles, and died from these causes nearly a week earlier, than the vines that were dusted when wet, yet they outyielded the latter by a significant margin. Apparently the additonal loss due to diseases and to insects, in excess of the loss

in the plots that were protected with the heavier coating of dust, was more than overcome by the additional vine growth and tuber development in the plots that were dusted when dry. It is difficult to explain the significant increase in yield of the plots that were dusted with the power machine when wet, over the plot that was dusted by hand when wet, unless it may be attributed to the additional injury to the plants caused by the operator walking through the vines in carrying the hand machine. It will be recalled that the power duster was driven through both the check plot and the hand-dusted plot. Since there was only one hand-dusted plot, and the degree of protection was as high in that plot as in the plots that were dusted with the power machine when wet, probably too much importance should not be attached to the increase in this particular case.

EFFICIENCY OF COPPER-LIME DUSTS CONTAINING DIFFERENT PERCENTAGES OF COPPER

Concerning the percentage of copper that should be used in copper-lime dust, Sanders and Kelsall (1920) state that they failed to obtain perfect control of late blight unless copper was present to the extent of 5 per cent or more, and that a mixture containing 7.5 per cent of copper gave better protection aga nst late blight and tuber rot than one containing 5 per cent of copper.

In 1921, three field experiments were conducted for the purpose of comparing the fungicidal values of dusts containing, respectively, 6, 8, and 10 per cent of copper. The 6-per-cent dust was compared with a 10-per-cent mixture, both at Southampton and at Bridgehampton, and with an 8-per-cent dust at Bridgehampton. In each experiment, equivalent amounts of copper were applied per acre in the two dusts under comparison. All applications were made in the morning, on wet foliage. A Niagara power potato duster was used on each farm. The tubers in the two middle rows of each plot were dug and weighed

Late blight, flea beetles, and tipburn were severe in the control plots of all three experiments. In experiment 1 at Southampton and experiment 2 at Bridgehampton, both the 6-per-cent and the 10-per-cent copper dust gave nearly perfect control of late blight and produced a marked reduction in injury from flea beetles and from tipburn. In experiment 3 at Bridgehampton, the plots that were dusted with the mixtures containing 6 and 8 per cent of copper showed considerable blight, and yielded at digging t me about 2½ per cent of rotted tubers. The duster in this experiment did not distribute the material as effectively as did those on the other two farms. No appreciable differences were observed in the degree of protection of the two dusts in any of the experiments, or in the appearance of the copper coatings on the foliage and their relative adhesiveness. No copper injury was noticed on the foliage in any of the plots.

Regarding the yields, it is seen from the data in table 25 that there was no appreciable difference in the results obtained with the 6-per-cen and the 10-per-cent copper dust. In experiment 3, however (table 26), there were some indications that the 8-per-cent copper dust was superior to the 6-per-cent mixture, although the increase in yield is less than three times its probable error. Considering the results from the three experiments, there s ems to be little difference between the efficiency of the 6-per-cent copper dust and a dust contain ng 8 or 10 per cent of copper.

TABLE 25. Yield of Green Mountain Potatoes Dusted with Copper-Lime Dusts Containing, Respectively, 6 and 10 Per Cent of Copper

Per cent of copper in dust	Yield, in bushels per acre	
	Experiment 1*	Experiment 2†
6	252.0	....
10	266.0	....
6	259.2	231.5
10	253.8	225.0
6	261.0	194.5
10	268.2	207.0
Check	248.4	170 5
6	270.0	190.1
10	273.6	194.3
6	244.8	205 8
10	259.2	209.6
6	306.0	....
10	280 8	....

Average increase in yield for 10-per-cent dust over 6-per-cent dust:
Experiment 1 = 1.16 ± 5.80
Experiment 2 = 1.45 ± 2.62

* The plots were 26 rods long and 4 rows wide.
† The plots were 48 rods long and 4 rows wide.

TABLE 26. Yield of Green Mountain Potatoes Dusted with Copper-Lime Dusts Containing, Respectively, 6 and 8 Per Cent of Copper*

Per cent of copper in dust	Yield, in bushels per acre
6	274.3
8	314.5
6	314.5
Check	285.2
8	325.0
6	292.0
8	304.5
6	269.7
Check	233.3
8	250.0
6	275.0
8	274.5

Average increase in yield for 8-per-cent dust over 6-per-cent dust = 14.18 ± 6.3

* The plots were 32 rods long and 4 rows wide.

COMPARISON OF COPPER-LIME DUST WITH SULFUR DUST

The results of earlier investigations indicated that sulfur applied to potato foliage in a spray was beneficial in one case and harmful in another, in its effects on the foliage and the yield. Jones and Giddings (1909) reported the results of a comparison of lime-sulfur with bordeaux mixture

on potato foliage in 1908. Very little early blight and no late blight were present, but tipburn was an important factor. Two applications of bordeaux mixture gave better protection against tipburn than did four applications of lime-sulfur, and produced a gain in yield of 67 per cent over the check in comparison with a gain of 37 per cent for the lime-sulfur. Four applications of bordeaux mixture afforded more than twice the protection against tipburn as did the same number of applications of lime-sulfur, and gave an increase in yield of 141 per cent over the check.

Stewart and French (1912) reported that lime-sulfur 1–40 caused a dwarfing of potato plants and a reduction in yield of 39.5 bushels per acre below the checks, as compared with an increase in yield of 100.3 bushels per acre for bordeaux mixture 6–6–50. No foliage injury was observed from the use of the sulfur spray, and the only injury noticeable in the experiment was tipburn. The plots sprayed with bordeaux mixture outlived by a considerable margin those sprayed with lime-sulfur.

In 1921 two experiments were conducted for the purpose of comparing a copper-lime dust containing 6 per cent of copper, with dusting sulfur. Experiment 1 was located on the farm of C. E. Dimon, Southampton, New York, and experiment 2 on the farm of H. T. Fahy Bridgehampton, New York. The copper-lime dust was applied at the rate of 50 pounds per acre at each application, and the sulfur at the rate of about 40 to 45 pounds. All applications were made in the morning, on damp vines. The duster in each experiment was a Niagara power potato duster with eight nozzles, two to a row. The rows in experiment 1 were 26 rods in length, and those in experiment 2 were 38 rods Ten applications were made in experiment 1 and nine in experiment 2.

Late blight was present in both experiments, but was much more severe in experiment 1. While the copper-lime dust was much more effective than the sulfur in controlling the late-blight fungus, the sulfured plots did not show as much foliage blight as did the check plots, indicating that the sulfur possessed some fungicidal value. In both experiments the plants under the two treatments were the same in size and appearance until blight, flea beetles, and tipburn became apparent. During the latter half of the season the sulfured rows suffered nearly as heavily from those injuries as did the check rows, and they died about twelve to fourteen days earlier than did the vines that were dusted with copper-lime. In experiment 2, in which late blight and flea beetles were not so prevalent but in which tipburn was decidedly more severe, the plots dusted with copper-lime remained green only about a week longer than did the sulfured plots and ten days longer than did the check. No tuber rot developed in any of the plots. The plants on either side of the area used in experiment 2, which the grower sprayed with bordeaux mixture, lived for at least a week after the dusted vines in the experimental plots were dead.

No foliage injury was observed as a result of the use of either of the fungicides, nor was any stunting effect noticed.

In regard to the yields, it is seen from the data in table 27 that in experiment 1 the plots dusted with copper-lime produced a significant increase in yield over the sulfured plots, but in experiment 2 the increase in yield was not so marked.

Another experiment was conducted during the same year, involving the use of sulfur and of a mixture of sulfur and hydrated lime. One

TABLE 27. YIELD OF GREEN MOUNTAIN POTATOES DUSTED WITH COPPER-LIME DUST AND WITH SULFUR, 1921

(Farms of C. E. Dimon, Southampton, New York, and H. T. Fahy, Bridgehampton, New York)

Dust	Yield, in bushels per acre	
	Experiment 1	Experiment 2
Sulfur	141.5	115.0
Copper-lime	150.5	155.0
Sulfur	125.8	142.5
Copper-lime	155.3	146.0
Check	114.8	115.0
Sulfur	122.9	140.0
Copper-lime	144.7	147.0
Sulfur	134.9	153.0
Copper-lime	158.3	161.0
Check	132.6	....
Sulfur	126 1	....
Copper-lime	159.9	....
Sulfur	139 7	....
Copper-lime	153.1	....

Average increase in yield of copper-lime dust over sulfur:
Experiment 1 = 21.34 ± 2.42
Experiment 2 = 13.91 ± 5.95

check plot of four rows was included. Late blight developed early in the plots and spread rapidly, and this disease, together with severe injury from flea beetles and from tipburn later in the season, caused the check p ants and the sulfured plants to die even earlier than did those in experiment 1 described above. The two experiments lay side by side. There was no appreciable difference in yield between the two treatments.

COPPER-LIME DUST COMPARED WITH NICOTINE DUSTS FOR APHIS CONTROL

In view of the fact that in some years aphids become destructive in Long Island potato fields, experiments were conducted to test the effectiveness of two nicotine dusts in comparison with a copper-lime dust containing no nicotine. One nicotine copper-lime dust, furnished by the Niagara Sprayer Company, contained about 6.5 per cent of metallic copper in the form of monohydrated copper sulfate, 10 per cent of calcium arsenate, and 1.9 per cent of nicotine sulfate; the remainder consisted of hydrated lime. The other nicotine dust, known as "Contact Special," was a mixture of dusting sulfur and finely ground tobacco shoots, with a nicotine content of about 1.9 per cent. The copper-lime dust used as a control fungicide was mixed to contain the same amount of copper and of calcium arsenate as the Niagara contact mixture. In each experiment a Niagara power potato duster was used. All applications were made in the early morning.

Experiment 1, 1921 (Farm of C. E. Dimon, Southampton, New York).—The first experiment comprised four plots dusted with the copper-lime

ust without nicotine, alternating with four plots treated with the copper-me-nicotine mixture. The field was 26 rods in length. Each material ras applied at the rate of about 50 pounds per acre. Two applications f a copper-lime dust were made by the grower before the infestation ppeared and the experiment began, and three were made after the terination of the test. The period of infestation lasted about five weeks, ut was serious for only two or three weeks. Six applications of dusts ere made in the experiment.

The two dusts were equally effective in controlling late blight, flea eetles, and tipburn. Observations indicated that there was a marked egree of aphis control in the nicotine plots. During the period of heaviest festation, there were more green uninjured leaves and fewer aphids those plots. The injury, however, was severe in all of the rows, and ter the nfestation abated and the vines recovered, the plants in all of e plots were more or less alike in appearance.

As may be seen from the data in table 28, the average increase in yield the nicotine plots over the checks was about four times its probable ror, and this indicates superior insecticidal properties for the dusts ntaining nicotine.

BLE 28. YIELD OF GREEN MOUNTAIN POTATOES DUSTED WITH NICOTINE DUSTS AND WITH A COPPER-LIME DUST CONTAINING NO NICOTINE, 1921

(Farms of C. E. Dimon, Southampton, New York, and H. S. Ludlow, Bridgehampton, New York)

Dust	Yield, in bushels per acre	
	Experiment 1	Experiment 2
oper-lime	259.0	277.8
oper-lime with nicotine	289.0	255.8
ntact Special	....	262.8
oper-lime	295.0	252.0
oper-lime with nicotine	302.0	253.2
ntact Special	...	242.7
eck (not dusted)	....	218.6
oper-lime	270 0	255.8
oper-lime with nicotine	265.5	230.4
ntact Special	...	240.5
oper-lime	258.3	237.0
oper-lime with nicotine	278.0	240.0
ntact Special	....	249.0

rage increase in yield of copper-lime dust with nicotine, over copper-lime dust:
Experiment 1 = 14.42 ± 3.54
Experiment 2 = 7.31 ± 5.33

rage increase in yield of Contact Special over copper-lime dust:
Experiment 2 = 0.15 ± 3.20

xperiment 2, 1921 (Farm of H. S. Ludlow, Bridgehampton, New York). n the second experiment, both the copper-lime contact dust and the ur contact dust (Contact Special) were used with the copper-lime dust

without nicotine. The arrangement of the plots is indicated by their sequence in table 28. Each plot contained four rows and was 20 rods long. All of the rows of each plot were dug and weighed. Three applications of a copper-lime dust were made by the grower before the experiment was begun, and two were made after the infestation of aphids. Four applications of the Special Contact dust were made. One plot of four rows received no treatment of any kind during the time of the experiment.

Late-blight infection was light even in the check plot, and was more noticeable in the plots protected with the Contact Special than in those dusted with the copper dusts. Injury from flea beetles and from tipburn was about the same in the dusted plots but was more severe in the check. The plots dusted with the Contact Special showed fewer aphids and less injury than did the check plot or the plots dusted with the copper-lime dust. The degree of control was slightly in favor of the copper lime contact mixture, but was not so marked as that described for experiment 1. In referring to the data on yields, in table 28, it is seen that there were no significant differences in the yields of the differently treated plots. The slight degree of aphis control was not reflected in the yields.

Experiment 3, 1922 (Farm of H. T. Fahy, Bridgehampton, New York). —The third experiment was conducted to test further the effectiveness of the copper-lime contact dust. There were four plots dusted with this mixture, alternating with four plots dusted with a copper-lime dust containing no nicotine. The plots were four rows in width and 38 rods in length. Three applications were made in a field that had been sprayed by the grower before the infestation of aphids appeared. The infestation was heavy again that year, and by the time the second application was made the younger parts of the shoots were severely curled. Thorough examination of the plants in the experimental plots and of those in the sprayed rows on either side showed little difference in the number of lice present after the three applications Examinations were made about one hour after, and again three days after, each application. There were no general differences in the degree of injury or in the appearance of the vines, in the differently treated plots. The experimental plots were not dug. The control of aphids with nicotine dust was not so marked in that season as in 1921.

INJURY TO POTATO PLANTS FROM FUNGICIDES CONTAINING COPPER

For the more recent investigations on the morphological and physiological effects of copper fungicides on potato plants, together with rather complete bibliographies and reviews of the earlier literature, the reader is referred to the works of Barker and Gimingham (1914), Lutman (1916), Duggar and Bonns (1918), Butler (1922), and Cook (1923).

Concerning the effects of the fungicides on plants in the foregoing experiments conducted on Long Island and in Washington County, there was no opportunity to ascertain any beneficial effect on the vines other than the protective action against fungous diseases, insects, and tipburn. In every experiment there was at least one or more of these sources of injury entering to influence the length of the growing period and the yield of the plants.

It is a well-known fact that vegetable and fruit growers, in prosecuting their plans for protection against diseases and insect pests, must take into consideration the liability of the plants to the so-called "bordeaux injury." The foliage of some plants is distinctly more susceptible than that of others to this type of injury. Practically all of the workers who have investigated the cause of the injury, attribute it to the absorption, in one way or another, of soluble copper. The symptoms seem to vary from local dead spots in the leaf, to partial or complete defoliation.

In the experiments extending over a period of three years in Suffolk County and one year in Washington County, there was no indication whatever of any local lesions on the stalks or the leaves, typical of the so-called "bordeaux injury," where copper sulfate and lime were employed in formulae varying from 4–4–50 to 7–7–50, or in corresponding formulae in which the ratio of hydrated lime was reduced to one-half. The same results were obtained in the greenhouse during the winter and spring months. Although the tipburn was believed to be the cause of the excessive foliage injury observed on foliage sprayed with sal-soda-bordeaux as compared with the amount of that type of injury in the plots sprayed with lime-bordeaux or dusted with copper-lime dusts, yet it appeared that in some cases the coating of the sal-soda-bordeaux was too heavy to afford so little protection against tipburn. Consequently it would not be surprising if a part of that type of injury was caused by substances in the preparation itself. Bedford and Pickering (1910), Butler and Smith (1919), and others have shown that if sal soda and copper sulfate are not mixed in the proper proportions, there may exist an excess of copper sulfate or sodium bicarbonate in solution, either of which may prove injurious to potato foliage.

Regarding foliage burn produced by the copper-lime dusts, no signs of such injury were noticed in 1920 with the use of the commercially mixed Sanders' dust containing 6 per cent of copper, or in 1921 with the same preparation used in Washington County. Furthermore, in the experiments in Suffolk County in 1921, when farm-mixed copper-lime dusts containing respectively 6, 8, and 10 per cent of metallic copper were applied to damp foliage, no injury from the materials was observed.

In the summer of 1922 an experiment was conducted for the purpose of determining the relation between the ratio of monohydrated copper sulfate, containing about 33 per cent of copper, to hydrated lime, and the degree of copper injury to potato foliage. The size and the arrangement of the plots, together with the composition of the dust mixtures, are given in table 29. Eleven applications were made with a hand duster at intervals of about seven days. With the exception of one application, all were made in the morning when there was little wind and when the foliage was wet. Rather heavy and very thorough applications were made by dusting each row from both sides, to give a two-nozzle-to-the-row effect. An attempt was made throughout to apply equivalent amounts of copper per acre in all of the plots. Observations were made frequently between applications, in order to ascertain the relative degrees of burning.

It will be recalled that in the experiments of 1922 on the control of diseases and insects, it was found that the dust mixture containing 10 per cent of copper produced a slight amount of burning, and was for that

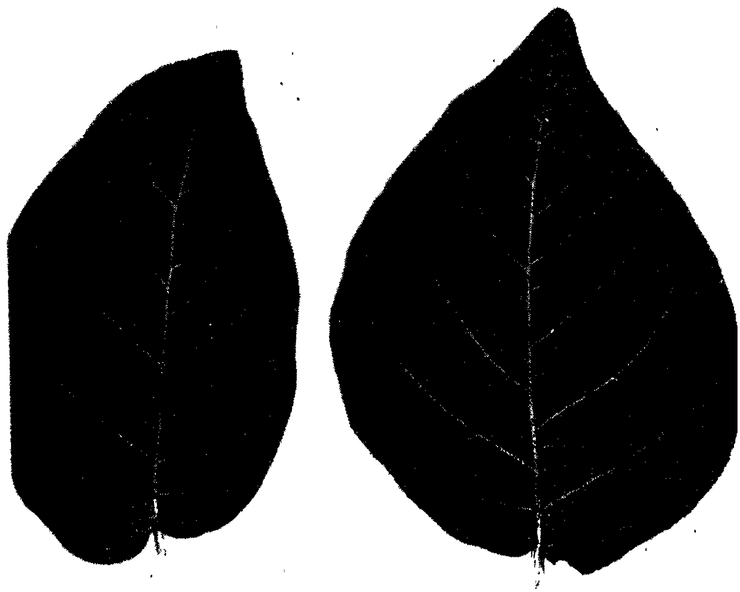
TABLE 29. Results of a Field Experiment Showing the Relation between the ratio of Monohydrated Copper Sulfate to Hydrated Lime in Copper-Lime Dusts, and the Degree of Burning on the Foliage of Green Mountain Potatoes, 1922

Length of plot (yards)	Number of rows in plot	Dust	Per cent of copper	Ratio of monohydrated copper sulfate to hydrated lime	Degree of copper injury or burning on the foliage
8	4	Copper-lime	20.0	1:0.5	Very severe
12	4	Copper-lime	17.1	1:0.75	Severe
21	2	Copper-lime	15.0	1:1	Considerable
27	2	Copper-lime	12.0	1:1.5	Slight
33	1	Check	....	.....	....
36	2	Copper-lime with Kayso	10.0	1:2	Very slight
44	2	Copper-lime	10 0	1:2	Very slight
50	2	Copper-lime	7.5	1:3	None
58	2	Copper-carb with lime	10.0	......	None
68	2	Copper-lime with gypsum	10.0	1:1	Considerable

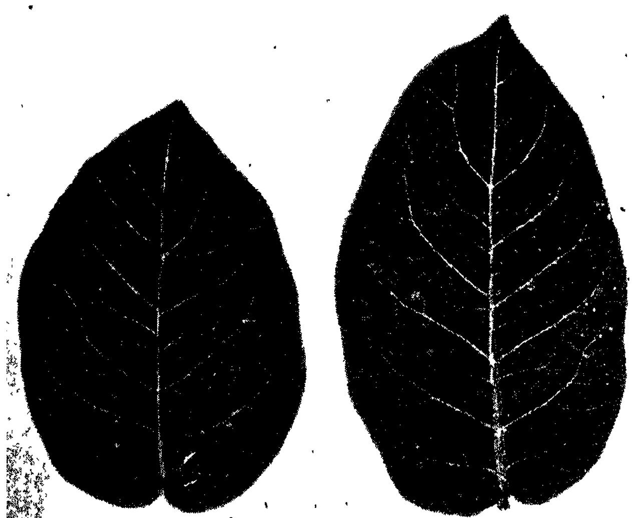
reason replaced until later in the season by a dust with 8.5 per cent of copper. The 8.5-per-cent dust produced no apparent injury, nor did the 10-per-cent dust later on when the vines were older. In the experiment outlined in the preceding paragraph, when the freshly mixed dusts were applied to wet foliage, copper burning was evident wherever dusts containing 10 per cent or more of copper were applied (table 29); and the higher the ratio of copper sulfate to hydrated lime, the greater was the injury. No injury was observed on the foliage dusted with the 7.5-per-cent copper dust, and only a slight amount in the first half of the season with the 10-per-cent mixture. The Copper-carb dust produced no burning whatever. The copper-lime dust in which gypsum, hydrated lime, and monohydrated copper sulfate were used in equivalent amounts, produced the same degree of burning as did the copper-lime dust with the same ratio of copper sulfate and lime but no gypsum.

The type of burning resulting from the use of dusts containing 12 and 15 per cent of copper was distinguished by the presence of numerous minute "burned" spots scattered over the leaves (figure 7). When examined closely, each spot appeared as a colorless, circular ring with a brownish, dead center. Such was the appearance from one to three or four days after each application. Later, the center of the lesion might fall away, leaving a perforation similar to those resulting from the feeding of flea beetles. Injury from the dusts higher in percentage of copper included, in addition to the small burned areas, larger patches of reddish brown, dead tissue which became dry and brittle (figure 8). The entire leaflet, expecially if a young one, might become rigid, curled upward at the margins, and retarded greatly in growth.

Experiments conducted in the greenhouse during the winter and spring, where diseases and insects were not present, gave results corresponding closely with those obtained in the field. The degree of burning, however,



IGURE 6. LEAVES FROM CONTROL PLANT, SHOWING NO COPPER INJURY



LEAVES DUSTED WITH A COPPER-LIME DUST CONTAINING 15 PER CENT OF COPPER, SHOWING A LIGHT DEGREE OF INJURY

FIGURE 8. LEAVES DUSTED WITH A COPPER-LIME DUST CONTAINING 20 PER CENT OF COPPER, SHOWING SEVERE INJURY

was slightly greater in the case of each dust, than was observed under field conditions. Bliss Triumph plants appeared to be more susceptible to this type of injury than did Irish Cobbler or Green Mountain plants. Furthermore, in view of the fact that in well-controlled greenhouse experiments it was found that the nature of the burning resulting from the copper-lime dusts was practically identical with that produced by applying varying amounts of monohydrated copper sulfate itself to wet foliage, or aqueous solutions of blue vitriol of varying concentrations, the cause of the burning was attributed to the entrance of soluble copper salts into the leaf. Also, when dehydrated copper sulfate or dusts high in percentage of copper were applied heavily to wet foliage, and the foliage was washed thoroughly immediately afterward to remove practically all of the coating, the amount of burning was very slight, indicating a probability that the injury was not due to the slight amount of heat evolved during the hydration of the dehydrated copper sulfate. When copper-lime dusts high in copper content, or dehydrated copper sulfate, were dusted on dry foliage, no burning resulted until the plants were moistened.

Regarding the stunting effect on plants receiving a relatively heavy coating of bordeaux mixture or copper-lime dust (pages 44 and 49), the same condition was observed in the hand-dusted experiment conducted to determine the amount of copper injury due to copper-lime dust. The heavier the coating of dust on the foliage, the more noticeable was the stunting effect on the plant as a whole, even in the plots that showed no

copper burning whatever. Furthermore, judging from the yields in the experiment of 1922, in which there was a comparison of the dusting of dry plants with the dusting of wet vines, it appears that this dwarfing might be accompanied by a reduction in yield (table 24, page 48). At any rate, the plants which were dusted when dry, and which for that reason possessed a very light coating of dust, produced a significantly higher yield than did those which were dusted when wet and therefore possessed a heavier coating of the fungicides. This difference of nearly ten bushels in yield was obtained in spite of the fact that the plants with the heavier coating of dust sustained less injury from fungous diseases and insects than did the other plants.

CHANGE IN SOIL REACTION RESULTING FROM APPLICATION OF FUNGICIDES

A few potato growers who had experienced difficulty with potato scab, questioned the advisability of using the copper-lime dust because of the probability of increasing the alkalinity of their soils through the application of so much lime. In order to determine whether or not any of the fungicides brought about a change in the reaction of the soil, a number of soil samples were taken in 1922 from plots that were treated with copper-lime dusts varying in percentage of lime, and from plots that were treated with bordeaux mixture. The samples were taken after digging. In determining the hydrogen-ion concentration of the soils the colorimetric method was used, employing Clark and Lubs' (Clark, 1920) color chart and standard buffers.

The results of the tests are given in table 30 and represent the averages of seven separate determinations. There appears to be an indication, in the Bridgehampton experiment, that the dusted plots showed a slight increase in alkalinity over the checks. In the duplicate experiments at

TABLE 30. RESULTS OF HYDROGEN-ION DETERMINATIONS OF SOIL SAMPLES TAKEN FROM DUSTED AND FROM SPRAYED POTATO PLOTS, 1922

Fungicide applied to plots from which tests were made	Number of applications of fungicide	Hydrogen-ion concentration, in terms of pH	
		Experiment at Southampton	Experiment at Bridgehampton
Copper-lime dust, 10 per cent of copper	13	4.86	4.88
Bordeaux mixture varying from 4–4–50 to 7–7–50	13	4.76	4.75
Checks*	..	4.84	4.71
Copper-lime dust, 7.5 per cent of copper	11	4.83	....
Copper-lime dust, 17.1 per cent of copper	11	4.70	....
Copper-lime dust, 10 per cent of copper, applied to dry foliage	13	4.83	....
Copper-lime dust, 10 per cent of copper, applied to wet foliage	13	4.88	....

* Two applications of a lime-calcium-arsenate mixture were made at the beginning of the spraying season.

Southampton, however, such a difference is not evident. Furthermore, at Southampton, where all of the plots were located in the same small field, which was level and appeared to be comparatively uniform throughout in the nature of the soil, there were no appreciable differences in the results of the copper tests, unless the value of pH 4.70 be considered significantly less than pH 4.83 and pH 4.88. Since the results in the duplicate dusting and spraying experiments were not consistent, and since there is no great difference between any two values in the table, it is doubtful whether the differences obtained are indicative of any appreciable changes in the hydrogen-ion concentration of the soil as brought about by the application of the fungicides.

RELATIVE COSTS OF DUSTING AND SPRAYING

In comparing the costs of dusting and spraying, the estimates were based on prices for 1922. Not all of the minor items of cost that might enter into the situation were considered. The principal items concerned are as follows: (1) the price of ingredients; (2) the time required to protect a given number of acres, together with the value of the time of men and teams; (3) the cost of mixing in the case of dusting, and of pumping or drawing water, making stock solutions, and so forth, in the case of spraying. It was assumed that the price of dusting and spraying machinery is about the same. There are other items that might be included, expecially if one wished to compare accurately the cost of dusting with home-mixed dusts and with commercially mixed dusts, because the latter involve such minor items in their preparation.

The estimates given in table 31 are based on the cost of protecting 25 acres, which is the average of about one day's dusting. The duster in use

TABLE 31. COST OF DUSTING AND SPRAYING IN 1922, APPLYING 3 POUNDS OF COPPER PER ACRE

(1) Cost of dusting with home-mixed copper-lime dust containing 10 per cent of copper and no arsenates:	
Price of monohydrated copper sulfate	$ 0.14
Price of hydrated lime	0.0125
Cost of mixing 750 pounds (for 25 acres)	0.75
Total cost of 750 pounds of dust	41.75
Cost of man and team for 9 hours, at 90 cents an hour	8.10
Total cost of dusting 25 acres	49.85
(2) Cost of spraying with bordeaux mixture 6–6–50, applying 100 gallons per acre:	
Price of 12 pounds of blue vitriol	$ 0.85
Price of 12 pounds of hydrated lime	0.15
Cost of materials for one tank	1.00
Cost of materials for 25 acres	25.00
Cost of preparing the spray mixture	1.00
Cost of man and team for 14 hours, at 90 cents an hour	12.60
Total cost of spraying 25 acres	38.60
(3) Cost of dusting 25 acres with commercially mixed copper-lime dusts containing no arsenates:	
(a) Containing 6 per cent of copper and purchased at 7 cents a pound	$95 60
(b) Containing 7 per cent of copper and purchased at 8 cents a pound	$93.70
(c) Containing 8 per cent of copper and purchased at 10 cents a pound	$101.85

was an engine-power, four-row machine, and the sprayer was a traction-power, six-row machine with two nozzles to a row. Both fungicides were applied at the rate of 3 pounds of copper per acre. It is seen that when home-mixed dust was used, although 25 acres were protected in two-thirds of the time in which they could have been sprayed, the cost of dusting was about 29 per cent higher. Furthermore, dusting with the purchased mixtures was considerably more than twice as expensive as spraying. It should be remembered, also, that with the type of duster in use in 1922, there was considerably less copper retained by the foliage for each pound of copper applied per acre, than in the spray, and that the loss from the leaves was greater. There are certain conveniences connected with dusting, however, which overcome some of the objectionable features of spraying, and these should receive their share of consideration in comparing total costs.

SUMMARY

The membranes formed when copper-lime dust is wetted are similar to those in bordeaux mixtures rich in lime, but they remain entire, not broken and scattered as in the spray.

When light applications were made of copper-lime dust and of dilute bordeaux mixture to give the same amount of copper per unit of area, a larger percentage of this area was covered by the spray membranes, due to their greater number and greater surface area, than by the dust membranes.

Under field conditions, about 44 per cent more copper for each unit amount applied per acre was retained by the foliage sprayed with bordeaux mixture than by the dusted foliage; and although a greater quantity of the copper was lost from the sprayed plants between applications, the percentage loss was less than that from the dusted plants. In greenhouse experiments on both glass plates and potato leaves, the spray coating proved more resistant to washings than did the copper-lime dust coverings.

Under both greenhouse and field conditions, only about half as much dust was retained by dry potato foliage as by thoroughly moistened leaves, and under field conditions the rate of loss from the dry-dusted foliage was higher.

The two bordeaux powders tested, copper-carbonate dust and Sanders' green copper-arsenic dust, did not exhibit as great a degree of adhesiveness to potato foliage in the greenhouse as did the copper-lime dust, due presumably to the fact that when the bordeaux powders are wetted no colloidal membranes are present. The rate of washing of the Copper-carb from the foliage was more than twice as high as that for the copper-lime dust.

The casein spreader, Kayso, produced no effect on the adhesiveness of either the copper-lime dust or the bordeaux mixture, but it increased, to a marked extent, the spreading qualities of the spray.

The amount of copper in rather high dilutions of bordeaux mixture necessary to inhibit germination of zoospores of *Phytophthora infestans* on glass slides, was found to be about 0.311 milligram per square meter. About twice this amount was required to prevent infection of plants in the greenhouse. In either case, the necessary amount of copper in the sprays was slightly less than that in the copper-lime dust, due no doubt to the greater covering power of the spray precipitate in mixtures of low concentration.

When equal amounts of copper were applied to damp foliage, in the copper-lime dust with a good hand machine or the best of the power dusters, and in the bordeaux mixture with exceptionally good sprayers, the control of early and late blight and of aphids appeared to be about equal in the two methods. The spray coating seemed to be superior in the control of flea beetles, leaf hoppers, and tipburn. Both of these fungicides were more effective against insects and tipburn than were sal-soda-bordeaux or the two proprietary bordeaux dusts, bordeaux-lead and Copper-carb.

The copper-lime dust when applied to dry foliage was less effective in controlling diseases and insect pests than when applied at the same rate to damp foliage, due to the greater amount that was retained by the moist leaves.

The various dusting machines used in the different experiments varied greatly in efficiency. Good hand dusters gave better results than did the power dusters used, due principally to a better distribution of the dust. To obtain an even distribution of dust on all parts of the plants, it seems to be essential that: (1) the nozzle should be so constructed that it will spread the dust into a wide stream so that the plants will be evenly enveloped; (2) there should be two nozzles to a row, so placed and directed as to produce a complete covering of the width of the row; (3) a blast of air should be created, sufficient to blow the dust out forcibly; and (4) the machine should feed evenly through the different nozzles.

There were strong indications, though no direct experiments to determine this question were made, that driving through the plots with sprayers or dusters produced injury to the vines, thus causing lower yields.

The results of the three years of experimentation in the comparison of copper-lime dust with bordeaux mixture, show that the sprayed plots produced an average gain in yield over the dusted plots of 7.2 bushels per acre. In all probability this increase is indicative, under the existing conditions, of the difference between the effectiveness of the two methods of protection.

Where copper-lime dusts containing respectively 6, 8, and 10 per cent of copper were used at rates so that equal amounts of copper were applied per acre, they showed no appreciable differences in the degree of protection against late blight and flea beetles, or in yields.

Sulfur, used either alone or mixed with hydrated lime, exhibited only slight protective properties against late blight, flea beetles, and tipburn. No injury to the foliage nor stunting of plants was observed.

In one experiment out of three, a copper-lime dust containing nicotine, when applied to damp foliage, proved superior to the same dust without nicotine in controlling aphids. A dust mixture known as "Contact Special," in which sulfur is the carrier, was not so satisfactory nor so effective for aphid control as was the copper-lime contact dust.

When freshly mixed copper-lime dusts containing from 10 to 20 per cent of copper were applied to wet foliage, there resulted a very slight burning of the leaves from the 10-per-cent dust and a severe injury from the 20-per-cent mixture, with a uniform gradation of burning between those limits. Dusts that contained less than 10 per cent of metallic copper produced no injury. The type of injury corresponded to that resulting when dehydrated copper sulfate is dusted on wet foliage, or when

a solution of blue vitriol is sprayed on dry foliage, and was attributed to the absorption of soluble copper salts.

There was strong indication, throughout the series of experiments, that heavy coatings of either dust or spray produced a dwarfing or a stunting effect on the plants. This effect was entirely independent of the occurrence of copper injury on the leaflets. There was repeated evidence also of plant injury, accompanied by reduction in yield, due to the passing of horses and machines through the plots.

The results of hydrogen-ion determinations made on samples of soils taken from plots that had received from eleven to fourteen applications of bordeaux mixture and copper-lime dusts, showed no significant difference in reaction from that in the check plots.

Based on the price of dusting and spraying materials in 1922, when 3 pounds of copper was applied per acre in each application, it cost about \$2 to dust an acre once with home-mixed copper-lime dusts, \$1.50 to spray an acre once, and from \$3.75 to \$4 to treat an acre once with commercial brands of dust.

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Economic Studies of Dairy Farming in New York. VI

Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1922

E. G. Misner

In cooperation with the Bureau of Agricultural Economics of the United States Department of Agriculture

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CONTENTS

ECONOMIC STUDIES OF DAIRY FARMING IN NEW YORK. VI. GRADE B MILK WITH CASH CROPS AND MIXED HAY ROUGHAGE, CROP YEAR 1922

E. G. MISNER[1]

In a preceding publication,[2] results of a study of the organization of dairy farms producing cultivated cash crops and having ordinary mixed-clover hay for roughage, are given for the year 1921. For the crop year 1922, 88 of the same farms were studied, and the results are given in this publication. For a description of the region and the normal precipitation in the area studied, and for the tenure status and employment history of the farm operators, the reader is referred to the bulletin just cited.

The farms included in this continued study are unusually well located on exceptionally productive land, and are operated by farmers of more than ordinary experience, training, and ability. The system of farming is well diversified for a section of the State where dairying is the leading enterprise. A large proportion of the cattle are purebred. From this it is apparent that the financial outcome, year after year, from the operation of these farms, is not greatly influenced by poor cultural methods, poor land, unstable markets, or disinterested and shiftless farmers. On the contrary, the area chosen for study is farmed by conscientious, hard-working farmers of unusual business ability, who have, in years past, made good livings from their farms and improved their properties. The financial returns for the past two years have not been what men of the type of these operators, located on farms as good as these and with markets as favorable, are entitled to as returns for their labor, management, and use of capital. The chief reason for this is that the expenses of operating have

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[1] The writer was assisted in the field by William Allen, J. F. Booth, J. S. Hathcock, and C. H. Merchant The information was gathered thru the cooperation of the Department of Agricultural Economics and Farm Management (G. F. Warren in charge) of the New York State College of Agriculture at Cornell University, Ithaca, New York, and the Divisions of Cost of Production (R. H. Wilcox in charge) and Farm Management (H. R. Tolley in charge) of the Bureau of Agricultural Economics (H. C. Taylor, Chief), United States Department of Agriculture, Washington, D. C.

The following farmers cooperated by furnishing information for the crop year of 1922:

Operators: L. A. Abbott, Frank Adams, L. W. Armstrong, H. S. Baker and son, W. J. Barber, Clayton Bartlett, M. H. Bartlett, F. A. Beecher, E. N. Bensley, W. L. Bierce, T. W. Billings, Ezra Briman, Leon Brown, John H. Burke, H. Button, Burt Butts, Frank H. Chrisman, W. G. Clark, Close and Hall, Coleman Bros., H. R. Cook, C. J. Coy, C. R. Crumb, Ivan Davidson, Lewis Dennis, F. H. Eddy, William E. Fairchild, J. J. Farley, M. W. Farley and son, D. N. Felt, S. A. Fisher, W. A. Follett, C. L. Frink, J. E. Gaines, P. J. Gilmartin, E. Gorton, L. D. Greene, H. D. Groves, F. F. Guthrie, Leo Hafelin, Clark Holmes, C. J. Hoose, John Howard, Charles Izard, C. H. Jantzen, W. P. Jeffrey, E. H. Jenne, Earl Jones, L. W. Knapp, H. N. Kutschbach, A. E. Lamb, J. W. Lamb, H. N. Lathrop, P. J. Lawrence, J. B. Marshall, Clarence E. Oakes, J. M. Olson, L. W. Paddelford, Leslie Reese, E. B. Reynolds, F. Rhoades, A. T. Ryan, A. C. Sabin, I. U. Scott, H. N. Sexton, W. H. Shapley, L. J. Slentz, E. P. Smith, F. J. Snell, E. J. Snitchler, A. Squires, C. B. Stowell, G. R. Sundell, A. P. Svenson, K. C. Thornton, R. R. Usher, Frank A. Van Housen, B. J. Van Wagner, R. H. Volmer, Floyd Wells, G. D. Whitford, L. L. Wilbur, C. G. Wilcox, H. H. Wilcox, M. L. Wilcox, G. W. Wood, S. S. Woodman, Thomas E. Wratten.

Landlords: Adelbert Abbott, Mrs. B. Bowers, Mrs. Bressee, C. J. Coleman, W. C. Crouch, Mrs. A. Davis, Mrs. B. R. Greene, A. A. Hartshorn, W. H. Hartwell, Clark Holmes, Mrs. Kinney, O. S. Langworthy, Henry Lathrop, W. J. Morse, W. F. Plumb, Alfred Reese, N. F. S. Russell, J. S. Sears, Mrs. L. M. Tanner, A. M. Tefft, William L. Titus, W. D. Usher.

[2] Economic studies of dairy farming in New York. IV. Grade B milk with cash crops and mixed hay roughage, crop year 1921. By E. G. Misner. Cornell Univ. Agr. Exp. Sta. Bulletin 441. 1925.

been abnormally high in relation to the prices received for the products. It is not to be expected that this relationship will continue. If it does continue, then it is not to be expected that these men will continue to operate their farms with the same degree of intensiveness as they have done for the past decade.

REGIONAL CONDITIONS

The average date of the last killing frost in the spring, at Oxford, is May 16, and that of the first killing frost in the autumn is September 27.[3] Oxford is the nearest weather station in the Chenango Valley, and the climate there is typical of the climate of the vicinity of Earlville and Sherburne, where the farms studied are located. The frost data are not available for Oxford for 1922, but at Norwich the last killing frost in the spring of that year was on May 1 and the first killing frost in the autumn was on September 26.[4]

The average precipitation at Norwich from April to August, inclusive, is 18.06 inches. For the year 1922 it was 26.36 inches; that is, the growing-season rainfall for 1922 was 146 per cent of the normal. The precipitation at Norwich, for each month from April to October, in per cent of the normal amount, is shown in table 1:

TABLE 1. Actual Amount of Rainfall at Norwich for the Crop Season of 1922, Compared with the Normal Amount

Month	Normal amount of rainfall at Norwich (inches)	Amount of rainfall at Norwich in 1922 (inches)	Per cent of normal amount of rainfall in 1922
April	3.14	3.48	110.8
May	3.56	4.05	113.8
June	3.57	9.10	254.9
July	4.08	2.29	56.1
August	3.71	7.44	200.5
September	4.08	1.50	36.8
October	3.42	1.91	55.8
Total, April–August	18.06	26.36	146.0

The fact that the precipitation was 146 per cent of normal makes the crop year 1922 rank as a very wet crop season. The crop yields for the year were 126 per cent of the long-time state average. This index results chiefly from an exceptionally good yield of corn for the silo (178 per cent of the average) and of hay (124 per cent of the average).

LABOR

The average value placed by the farm operators on their time for twelve months was $1017, or $84.78 per month. This estimate of the value of

[3] Summary of climatological data for the United States, by sections. Reprint of Section 103, page 8.
[4] Climatological data, volume XXXIV, Ithaca, New York, Annual 1922, no. 13, page 97.

time is the same as for the preceding year. The variations in the estimates are given in table 2:

TABLE 2. Variations in Estimates Placed by Farm Operators on the Value of Their Time for Twelve Months

Value of operator's labor	Number of farms	Per cent
$ 500	1	1.1
600	5	5.7
700	1	1.1
720	3	3.4
750	1	1.1
780	1	1.1
800	5	5.7
880	1	1.1
900	17	19.3
915	1	1.1
930	2	2.3
960	1	1.1
1,000	18	20.5
1,020	1	1.1
1,075	1	1.1
1,095	1	1.2
1,100	1	1.2
1,200	19	21.6
1,500	6	6.8
1,630	1	1.2
2,000	1	1.2
Total	88	100.0

The average monthly wage paid to hired men without board in 1922 was $64 per month, the same as for the preceding year.

The average wage paid to hired men with board was $43 per month, also the same as for the preceding year. The cost of that part of the board furnished that was purchased, excluding the part furnished by the farm, was $18.72 per month. This was $1.28 per month more than for the year 1921.

The average number of persons engaged in operating these farms, expressed in equivalent of men for the year, was 2.19 per farm, as compared with 2.33 per farm for the preceding year. Of the total months of labor, 45.7 per cent was time spent by the operator, 21.4 per cent by other members of the operator's family, and the remaining 32.9 per cent by other persons. The family labor on these farms in 1922 represents a larger proportion of the total time spent than in 1921. The unfavorable returns from the preceding year resulted in the hiring of less labor. This was true also in an area producing Grade B milk with alfalfa roughage.[5]

[5] Bulletin 438 of this experiment station.

The details of the labor on 88 farms in 1922 are given in table 3.

TABLE 3. LABOR ON 88 FARMS

	Number of farms using	Months worked			Value of unpaid labor		Total wages		Average per month worked	
		Total	Per cent	Per farm	Total	Average per month	Cash	Board	Cash	Value of board
Operator's wife:										
Paid	1	1	0.1	1.0	....	.....	$ 35	.....	$35 00	....
Unpaid	49	135 8	10 8	2.8	$7,759	$57.14	.....	.....	....	....
Operator's sons:										
Paid	4	53	4 2	13.2	.....	.....	1,640	$ 915	30.94	$17.26
Unpaid	26	186	14.8	7.2	9,989	53.70	.....	....	....	....
Operator's daughters:										
Unpaid	1	3	0.2	3.0	180	60.00	.....	.....	....	....
Operator's other relatives										
Paid	4	33	2.6	8.2	.....	.....	1,120	575	33.94	17.42
Unpaid	10	84	6 7	8 4	4,491	53.46	....	.....	....	....
Landlord	1	1	0.1	1 0	50	50.00	....	....	....	....
Hired men, without board	22	203	16.2	9.2	.....	.....	12,995	.....	64.01	....
Hired men, with board.	51	483.3	38.5	9 5	.....	....	20,839	9,049	43.12	18.72
Hired men, board only	1	4	0 3	4.0	.....	.....	....	60	....	15.00
Hired men, by day:										
Without board	38	59 4	4 7	1 6	.....	....	4,752	....	80.00	....
With board	12	9 8	0.8	0 8	....	.....	412	130	42.04	13.27
Other help, paid	1	0.5	.	0 5	...	.....	12	5	24.00	10.00
Total labor, except operator.	88	1,256 8	100 0	14.3	$22,469	$54 83	$41,805	$10,734	$49.59	$18.30
Operator	88	1,022	....	11.6	$86,905	$85 03	..	.....	...	....
Son's share as operator	4	26	..	6.5	2,060	79.23	...	.....	....	....
Father's share as operator	1	1	....	1.0	90	90.00	.....	.....	...	....
Hired men's share as operator	4	7	....	1 8	470	67 14	...	.....	....	....
Total for 12 months time, for operator	88	1,056	....	12.0	$89,525	$84.78	..	...	....	....
Man equivalent	....	.....	....	2.19	.....	.....	.....	...	....	....

FARM CAPITAL

The average size of the 88 farms studied for the year 1922 was 151 acres, with 59 acres, or 39 per cent of the total area, in crops, and with 64 acres in permanent pasture. In addition to this some woodland was pastured, the equivalent to 2.4 acres of open pasture per farm. (Table 4.)

TABLE 4. AVERAGE SIZE OF 88 FARMS

	Average acres per farm	Per cent of total acres
Crop land	59.0	39.2
Woods pastured*	10.8	7.2
Rotated pasture	0.2	0.1
Permanent pasture tillable	33.0	21.9
Other permanent pasture	31.4	20.9
Woods not pastured	8.2	5.4
Farmstead, roads, and so forth	8.0	5.3
Total	150.6	100.0

* Equivalent to 2.4 acres of open pasture.

The farms included for the year 1921, as reported in Bulletin 441, contained 17 total acres more per farm and 4 acres of crops more per farm than those included in 1922.

The capital per farm averaged $16,080, of which 67.3 per cent was in real estate, 25.9 per cent was in livestock, and 6.8 per cent was in machinery (table 5). The total capital per farm was about the same as the average for the 121 farms included in the study for the preceding year.

TABLE 5. AVERAGE CAPITAL FOR 88 FARMS

	Value per farm	Per cent of total
Real estate	$10,818	67 3
Livestock	4,166	25 9
Machinery	1,096	6.8
Total	$16,080	100.0

The proportion of the capital in livestock is higher for these farms than for any of the areas reported in previous bulletins of this series, because of the larger proportion of purebred livestock having a high per-unit valuation.

FARM RECEIPTS

Of the total income from these farms, 57.2 per cent was cash for milk sold, 3.5 per cent was in certificates of indebtedness of the Dairymen's League Cooperative Association, Inc., 15.7 per cent was from livestock sold, 13 per cent was from crops sold, and 10.6 per cent was from miscellaneous sources (table 6). The total receipts per farm in 1922 were $4550, the average being $532 less, or about 10 per cent less, per farm than for the year 1921. In the vicinity of Munnsville, a region producing Grade B milk with alfalfa, the receipts were 14 per cent less per farm in 1922 than in 1921.

TABLE 6. AVERAGE RECEIPTS PER FARM

	Average per farm	Per cent of total
Crops sold	$ 592	13 0
Livestock sold	713	15 7
Milk sold:		
Cash	2,600	57 2
Certificates of indebtedness	161	3 5
Increase in inventory	104	2.3
Miscellaneous	380	8.3
Total	$4,550	100.0

CROPS

The crops grown, the total yields, and the receipts from crops sold, are shown in table 7:

TABLE 7. CROPS RAISED ON 88 FARMS

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Corn for grain	48	1,682.5	Bushels...	......	......	......	....
Stover from corn for grain	....	66	Tons.....	......	......	......	....
Corn for the silo	721	7,961	Tons.....	19	$ 43	9	$ 27
Corn for fodder cured	17	51	Tons.....	......	......	......	....
Other corn fed green	8	92	Tons.....	......	......	......	....
Oats	476	13,738	Bushels...	......	......	......	....
Oat straw	....	440.5	Tons.....	3	17	......	....
Oats and barley	134	4,736	Bushels...	......	......	......	....
Oat and barley straw	....	106	Tons.....	......	......	......	....
Barley	44	1,036	Bushels...	213	318	......	....
Barley straw	....	40	Tons	3.5	26	......	....
Buckwheat	23	521	Bushels...	118	74	6	8
Buckwheat straw	....	9	Tons.....	......	......	......	....
Winter wheat	62	1,441	Bushels...	420	506	80	85
Wheat straw	....	37.5	Tons	......	......	......	....
Oats and peas	6	234	Bushels...	......	......	......	....
Oat and pea straw	....	6	Tons.....	......	......	......	....
Oats, peas, and barley	10	300	Bushels...	......	......	......	....
Oat, pea, and barley straw	....	5	Tons.....	......	......	......	....
Barley and buckwheat	4	96	Bushels...	......	......	......	....
Barley and buckwheat straw	....	2	Tons.....	......	......	......	....
Oats for hay	40	68	Tons.....	......	......	......	....
Oats and peas for hay	29.5	63	Tons.....	......	......	......	....
Oats and barley for hay	5	8	Tons.....	......	......	......	....
Oats fed green	1	2.5	Tons.....	......	......	......	....
Oats and peas fed green	19.5	39	Tons.....	......	......	......	....
Oats and buckwheat fed green	1	5	Tons.....	......	......	......	....
Buckwheat fed green	3	7	Tons.....	......	......	......	....
Rye fed green	1	2	Tons.....	......	......	......	....
Millet fed green	4.8	13	Tons	......	......	......	....
Millet for the silo	1	5	Tons.....	......	......	......	....
Sudan grass fed green	3.3	13	Tons.....	......	......	......	....
Sudan grass fed green, second cutting*	(2)	6	Tons.....	......	......	......	....
Alfalfa fed green, second cutting*	(15)	30	Tons	......	......	......	....
Alfalfa fed green, third cutting*	(17)	23	Tons	......	......	......	....
Rowen fed green*	(41.5)	51	Tons	......	......	......	....
Alfalfa, first cutting	156	302	Tons.....	8	96	......	....
Alfalfa, second cutting*	(127)	148	Tons.....	......	......	......	....
Alfalfa, third cutting*	(49)	42	Tons.....	......	......	......	....
Mixed hay (clover)	793	1,623	Tons.....	16	205	......	....
Mixed hay (other)	1,390	2,200	Tons.....	100	1,078	10	100
Timothy	571	1,068	Tons.....	94	1,148	14	144
Timothy sold standing	6	......	....	......	60	......	....
Rowen*	(229)	205	Tons.....	......	......	......	....
Sudan grass	5	6	Tons.....	......	......	......	....
Millet and sudan grass	13	19	Tons.....	......	......	......	....
Millet	15	25	Tons	......	......	......	....
Potatoes	131.7	13,315	Bushels...	6,327	4,042	324	258
Cabbage	221.1	2,146	Tons.....	1,277	11,230	150	791
Cabbage refuse	....	239	Tons.....	......	......	......	....
Market peas	184.5	17,558	Bushels...	16,130	28,374	1,428	2,543
Peavines (cured)	....	6	Tons.....	......	......	......	....
Peavines (green)	....	36.5	Tons.....	......	......	......	....
Field beans	1	15	Bushels...	13	70	......	....
Beets and mangels	4.3	38.1	Tons.....	0.8	20	......	....
Apples†	36.5 *(19.5)	......	Barrels...	138	667	12	83
Strawberries	0.1	......	Quarts...	150	30	......	....
Asparagus	....	......	Bunches..	125	40	......	....
(Fallow land)	3	......	....	......	......	......	....
Total	5,193.3	......	....	......	$48,044	......	$4,039

* These acres are not included in the total acres of crops.

† Most of the orchards of this area consisted of scattered trees, and the yields were not ascertained.

Of the total crop area, 15.3 per cent was in corn crops, 14.8 per cent was in oats and barley, and 10.4 per cent was in cabbage, potatoes, and market peas. Except for a small acreage of wheat and miscellaneous crops, the remaining 59.5 per cent of the total crop area was in hay. The average yield per acre of corn for the silo was 11 tons, oats threshed 28.9 bushels, mixed hay clover 2 tons, other mixed hay 1.6 tons, potatoes 101 bushels, market peas 95 bushels, and cabbage 9.7 tons. The yields of all crops except hay were better in 1921 than in 1922. The exceptionally heavy precipitation in April, May, and June, 1922, resulted in a very large hay crop but also caused a decreased yield of peas and drowned out several acres of other crops.

The crop index is a number that represents the relative yield of crops as compared with the average yield of the same crops in New York as 100. The index for corn for the silo was 178, for oats 87, and for hay 124. If the indexes for these three crops were weighted according to the proportion of the work units spent on each, their net weighted index would be 144.

The varieties of corn grown for the silo in 1922 on 84 of these farms are listed in table 8:

TABLE 8. SUMMARY OF VARIETIES OF CORN FOR THE SILO, 84 FARMS

Variety	Acres	Per cent
West Branch	175.0	24.3
Luce's Favorite	160.5	22.3
Sweepstakes	149.0	20.7
Leaming	75.5	10.5
Eureka	60.0	8.3
Pride of Nishua	22.0	3.0
Golden Ensilage	18.0	2.5
Early Michigan	9.0	1.2
Bloody Butcher	8.0	1.1
Pride of the North	7.0	1.0
State	6.0	0.8
Cornell No. 11	4.0	0.6
Early Wonder	3.0	0.4
Grow More	2.5	0.3
Golden Nugget	2.5	0.3
Golden Glow	2.0	0.3
Kinds not found	17.0	2.4
Total	721.0	100.0

Of the total acreage, 24.3 per cent was West Branch, 22.3 per cent was Luce's Favorite, and 20.7 per cent was Sweepstakes. These three varieties represent more than two-thirds of the corn for the silo. The tendency seems to be to change from Luce's Favorite, of which more was grown in the preceding year, to Sweepstakes, particularly the strain of Sweepstakes known as West Branch.

LIVESTOCK

Statements of the inventories, purchases, sales, and deaths of cattle and other livestock in 1922, appear in tables 9 and 10. The average numbers of the more important animals per farm were as follows: cows,

TABLE 9. APPRECIATION AND DEPRECIATION ON DAIRY CATTLE, 88 FARMS

	Cows						Heifers											
	Grade			Purebred			Grade						Purebred					
							One year or over			Under one year			One year or over			Under one year		
	Number of farms	Number of cows	Value	Number of farms	Number of cows	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value
On hand May 1, 1922	72	1,215	$107,781	54	673	$116,765	50	197	$9,330	47	162.5	$4,471	46	263	$31,465	42	224.5	$15,228
Purchased during year	24	248	20,479	8	46	5,440	8	38	1,840	6	24	322	6	26	2,780	5	16	470
Born during year	....	......	....	....	....	.....	....	......	......	47	163	809	...	......	......	34	217	6,756
Heifers that became cows	47	141	10,905	37	192	29,060	....	......	......	....	...	......	....	....	......	....	......	....
Total	....	......	$139,165	....	....	$151,265	....	.....	$11,170	...	.....	$5,602	....	......	$34,245	....	.....	$22,454
Sold	58	320.5	$ 22,121	35	175.5	$ 20,103	12	22	$ 997	3	15	$ 850	4	18	$ 3,050	10	38	$ 1,426
Died or killed by accident	17	27	......	14	16	......	6	7	......	2	6	......	4	5	......	....	.....	....
Hides sold	10	13	45	8	14	49	2	5	12	....	....	......	2	2	5	....	.....	....
Heifers that became cows	....	......	......	....	....	.....	47	141	10,905	....	.....	......	37	192	29,060	....	......	....
Used for food	6	5.5	226	3	2.5	110	....	......	......	...	.....	......	1	1	75	...	.....	.....
On hand April 30, 1923	69	1,251	113,599	53	717	124,625	50	209	9,924	50	184.5	4,284	48	284	32,210	39	208.5	13,295
Total	....	......	$135,991	....	....	$144,887	....	......	$21,838	....	.....	$5,134	....	......	$64,400	....	......	$14,721
Appreciation	......						$32,622											
Depreciation	$9,552						......											

TABLE 9 (*concluded*)

	Herd bulls						Veals			Bull calves to be sold		
	Grade			Purebred								
	Number of farms	Number of bulls	Value	Number of farms	Number of bulls	Value	Number of farms	Number of veals	Value	Number of farms	Number of calves	Value
On hand May 1, 1922	14	14 3*	$1,825	64	73.1†	$13,554	...	.	. .	5	12	$1,090
Purchased during year	5	5	172	18	18 5	1,905						
Born during year	4	4	26	11	11	357	81	1,216	$2,923	7	18	840
Heifers that became cows		.. .	.....	.. ..	.....	... .	. .	.	. ..	.	. ...	......
Total		.. .	$2,023	. .	.....	$15,816	.	. ..	$2,923	.		$1,930
Sold	5	5	$ 180	35	32 9	$ 2,423	81‡	120 1,084	$ 855 2,799	6	16	$1,560
Died or killed by accident	...		.....	1	1	..	. . .	. . .	.	1	1	..
Hides sold	1	1	4	. ...	..	.	.	. .	.			.
Heifers that became cows			. .	. .	..		.	....	....	.	.	. ...
Used for food	1	1	30	. .	. .	.	. .	.	.		.	.. .
On hand April 30, 1923	17	17 3*	1,715	56	68 7†	11,854	3	12	129	3	13	924
Total		.	$1,929	.... .	.. .	$14,277	.	. .	$3,783	.	.	$2,484
Appreciation								$860			$554	
Depreciation			$1,633									

* Including 3 grade bulls not owned, but kept for service on 3 farms.
† Including 1 purebred bull not owned, but kept for service on 1 farm.
‡ 8 farms sold 120 fat veals, and 74 farms sold 1084 veals at birth.

TABLE 10. SUMMARY OF LIVESTOCK OTHER THAN DAIRY CATTLE, 88 FARMS

	Inventory at beginning of year			Purchases			Sales			Inventory at end of year			Died		Used for food		
	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Number of farms	Number of head	Value
Horses	87	307	$45,140	23	39	$4,870	15	22	$2,168	87	312	$42,770	14	16			
Colts	7	13	1,160	1	1	35				7	12	1,380	1	1			
Mules	4	9	1,200				1	2	115	4	0	1,225					
Ponies	1	1	25							1	1	25					
Stallions	2	2	550							2	2	450					
Sheep, ewes	1	43	215	1	49	245	1	6	40	2	93	695					
Sheep, bucks				1	1	10				2	2	20					
Lambs, weaned							1	32	480								
Brood sows	8	11	390	2	2	39	3	5	175	8	12	408	2	2			
Boars	2	2	45							2	2	65					
Other hogs	17	32	503	11	22 5	206	8	9 5	221	13	27	481			20	37	$1,176
Pigs, weaned				8	16	87	5	58	305	4	9	64					
Chickens	78	7,308	9,329	8	901	569	43	4,472	2,835	79	9,538	12,257					
Baby chicks				14	2,862	449	2	344	48								
Turkeys	1	3	38				1	1	5	2	6	48					
Ducks				1	4	3	1	4	4								
Bees	2	21*	465							2	26*	250					
Total	...		$59,060	...		$6,513			$6,396			$60,138					$1,176

* Colonies.

21.9; heifers one year old or over, 5.4; heifers under one year, 4.4; bulls, 1.0; horses (and mules), 3.6; chickens, 96.

The total number of animal units per farm was 32.8, and of animal units excluding work animals, 29.2. Of the cows on hand, 36 per cent were purebred; in 1921, on 121 farms, 30.7 per cent of the cows were purebred. Of the heifers one year old or over, 57.4 per cent on these farms were purebred as compared with 53.8 per cent on 121 farms in 1921; and of the heifers under one year old, 55.5 per cent were purebred as compared with 57.3 per cent on the 121 farms in 1921. Of the bulls, in 1921, 79.9 per cent were purebred; in 1922, 81.8 per cent were purebred. The appreciation on cattle was $395 per farm in 1922, as compared with $528 per farm in 1921. This is much higher than on farms producing Grade B milk where a large proportion of the cattle were purchased. The depreciation on horses was 12.1 per cent of their average value, and amounted to $62 per farm.

MILK SOLD

Receipts from milk sold in 1922 are shown in table 11 (page 14).

The butterfat test for the year averaged 3.3 per cent, but varied from 3.3 to 3.4 per cent in different months. The range in the butterfat test is lower in this region than in any of the other areas studied and reported in this series of bulletins.

The average pool price paid to farmers for milk sold to the Dairymen's League Cooperative Association, Inc., was $2.07 per 100 pounds for the year 1922, including 14 cents in the form of certificates of indebtedness and $1.93 cash. This price was 7 cents more per 100 pounds than for milk sold in the preceding year. The price received for milk not sold thru the Cooperative Association was $2.53 per 100 pounds, or 46 cents more per 100 pounds than that paid by the Cooperative Association. Since the non-pooled milk tested 3.4 and the pooled milk tested 3.3, the difference was only 42 cents for milk with the same butterfat test. The average amount of money paid to the Cooperative Association for milk pooled was $2.31 per 100 pounds, or 24 cents more per 100 pounds than the farmer received for the milk. In addition to the pool price given, 1.88 cents per 100 pounds was returned to poolers to cover unpaid amounts from April 1, 1922, to March 31, 1923. All gain or loss figures in this bulletin should be corrected by this amount.

In 1921, milk not sold thru the Cooperative Association returned the farmers 37 cents more per 100 pounds than was paid by the Cooperative Association to its members.[6]

Of the total milk sold during the year, 88 per cent was sold thru the Dairymen's League Cooperative Association. In the preceding year, on 121 farms in this area 77 per cent of the milk was sold thru the Cooperative Association.

[6] Bulletin 441 of this experiment station, page 20.

TABLE 11. RETURNS FROM MILK SOLD, 88 FARMS

	Milk pooled									Milk not pooled					
	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butterfat	Amount dealer paid for milk	Amount received by farmers for milk: Certificates of indebtedness	Cash	Total	Total per 100 pounds	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butterfat	Amount dealer paid for milk	Amount received by farmers for milk per 100 pounds
1922:															
May (pasture)	....	603,827	19,995	....	$ 9,573	$ 604	$ 7,734	$ 8,338	.....	...	56,819	1,880	...	$ 993	
May (winter)	....	496,288	16,459	...	7,858	497	6,445	6,942	...	..	58,242	1,930	.	1,017	.
May (total)	79	1,100,115	36,454	3.3	17,431	1,101	14,179	15,280	$1.39	9	115,061	3,810	3.3	2,010	$1.75
June	79	1,039,018	34,065	3.3	16,527	1,029	13,674	14,703	1.42	9	127,081	4,226	3.3	2,152	1.69
July	79	791,815	26,305	3.3	15,409	1,583	11,957	13,540	1.71	9	101,049	3,408	3.4	2,158	2.14
August	79	638,115	21,450	3.4	14,345	950	10,844	11,794	1.85	9	76,531	2,677	3.5	2,003	2.62
September	79	658,267	22,342	3.4	16,627	983	12,914	13,897	2.11	9	78,927	2,787	3.5	2,099	2.66
October (pasture)	....	477,382	16,130	..	11,664	952	10,115	11,067	.....	..	78,966	2,745	..	2,139	
October (winter)	....	240,456	8,069	....	6,081	481	5,096	5,577	.....	...	26,131	879	....	700	
November (pasture)	....	6,176	210	....	178	12	146	158	......	.	......	...	....	..	.
November (winter)	...	709,134	23,534	...	18,804	1,418	16,610	18,028	......	...	105,767	3,740	...	2,931	..
October (total)	78	717,838	24,199	3.4	17,745	1,433	15,211	16,644	2.32	10	105,097	3,624	3.4	2,839	2.70
November (total)	77	715,310	23,744	3.3	18,982	1,430	16,756	18,186	2.54	11	105,767	3,740	3.5	2,931	2.77
December	77	803,448	26,891	3.3	24,100	1,611	21,276	22,887	2.85	11	107,510	3,795	3.5	3,440	3.20
1923:															
January	77	915,023	30,588	3.3	24,632	914	20,125	21,039	2.30	11	108,285	3,718	3.4	3,544	3.27
February	77	824,429	28,222	3.4	21,150	829	18,974	19,803	2.40	11	107,083	3,675	3.4	2,850	2.66
March	77	940,020	31,157	3.3	23,247	940	19,885	20,825	2.22	11	137,208	4,543	3.3	3,554	2.59
April	74	932,183	30,872	3.3	22,653	1,389	18,569	19,958	2.14	14	177,143	5,911	3.3	4,515	2.55
Total:															
Pasture	....	4,214,600	140,497	3.3	$84,323	$6,113	$67,384	$73,497	$1.74	..	519,373	17,723	3.4	$11,544	$2.22
Winter	....	5,860,981	195,792	3.3	$148,525	$8,079	$126,980	$135,059	$2.30	....	827,369	28,191	3.4	$22,551	$2.73
Year	....	10,075,581	336,289	3.3	$232,848	$14,192	$194,364	$208,556	$2.07	...	1,346,742	45,914	3.4	$34,095	$2.53

The monthly distribution of the production of milk, the average butter-fat test, and the monthly receipts per farm from milk sold, are given in table 12:

TABLE 12. DISTRIBUTION OF MILK PRODUCTION, 88 FARMS

	Total pounds of milk sold wholesale	Per cent	Butter-fat test	Value per farm, including certificates of indebtedness
1922:				
May	1,215,176	10.7	3.3	$197
June	1,166,099	10.2	3.3	192
July	892,864	7.8	3.3	178
August	714,646	6.2	3.4	157
September	737,194	6.5	3.4	182
October	822,935	7.2	3.4	221
November	821,077	7.2	3.3	240
December	910,958	8.0	3.4	299
1923:				
January	1,023,308	8.9	3.4	279
February	931,512	8.2	3.4	257
March	1,077,228	9.4	3.3	277
April	1,109,326	9.7	3.3	278
Total	11,422,323	100.0	3.3	$2,757
Total pasture	4,733,973	41.4	3.3	$966
Total winter	6,688,350	58.6	3.3	$1,791

MISCELLANEOUS RECEIPTS

The miscellaneous farm receipts are given in table 13. Eggs, cordwood, lumber, and work done off the farm, constitute the chief miscellaneous sources of income. The average amount received per farm was $380.

TABLE 13. MISCELLANEOUS RECEIPTS, 88 FARMS

	Amount	Price	Value		
			Farm	Operator	Landlord
Human labor off farm	425.5 days	$3.61	$ 1,535	$ 1,484	$ 51
Horse labor off farm	379.5 days	1.73	655	653	2
Produce dealing	......	......	545	545	......
Association work	......	......	600	600	......
Use of machinery	144 days	5.57	802	771	31
Rent of house	......	......	164	136	28
Rent of pasture	......	......	337	337	......
Maple sirup	407 gallons	1.87	762	762	......
Maple sugar	125 pounds	1.32	165	165	......
Honey	500 pounds	0.20	98	98	......
Wool	200 pounds	0.33	66	66	......
Eggs	48,651 dozen	0.34	16,430	16,102	328
Baby chicks	710	0.15	106	106	......
Breeding fees	......	......	464	464	......

TABLE 13 (*concluded*)

	Amount	Price	Value		
			Farm	Operator	Landlord
Feed bags	17,494	$0 03	$ 580	$ 566	$14
Hides	170	2 15	365	341	24
Wood	740 cords	2 39	1,772	1,712	60
Lumber	1,052 3 thousand feet	1 52	1,597	1,582	15
Posts	700	0 11	75	75	.
Gravel	. .	. .	967	967	. . .
Insurance	. . . .	. .	4,380	4,380	
Premiums at fair	. .	. .	52	26	26
Hauling milk	. . . . .		144	144	. . . . .
Ice	4,600 cakes	0 05	230	230	. .
Cabbage plants	14,000	1 79	25	25	. . . .
Testing	. . . . .	.	96	96	. . . . .
Other miscellaneous income	. . . . .	.	400	400	. . .
Total	. . . .	. .	$33,412	$32,833	$579
Per farm	. .	.	$380	$373	$7

FARM EXPENSES

In 1922 the current operating expenses per farm were $3221, of which 32.2 per cent was for cattle and horse feed, 26.4 per cent was for labor, 5.9 per cent was for taxes, and 35.5 per cent was for other items (table 14). The average expenditure per farm for new buildings was $39, and for livestock purchased $454, making a total of $3714 per farm.

TABLE 14. EXPENSES ON 88 FARMS

	Value		
	Total	Per farm	Per cent
Labor, hired	$41,805	$ 475	14.7
Labor, unpaid	22,469	255	7 9
Board of hired labor	10,734	122	3.8
Advertising	39	0	0 0
Baling	45	1	0 0
Barrels, baskets, bags, etc	3,202	36	1.1
Bedding	388	4	0.1
Breeding fees	139	2	0.1
Building repairs, roofing, paint	4,350	49	1.5
Pasturage	888	10	0.3
Commissions, storage	2,737	31	1.0
Freight, express, cartage	4,924	56	1.7
Drains	15	0	0.0
Salt	919	10	0.3
Hay, silage, straw, stalks	1,716	20	0.6
Poultry and hog feed	10,273	117	3.6
Cattle and horse feed	91,259	1,037	32.2

TABLE 14 (*concluded*)

	Value		
	Total	Per farm	Per cent
Sheep feed	$ 269	$ 3	0.1
Grinding feed	463	5	0.2
Fence, wire, posts, staples	1,363	15	0 5
Fertilizer	7,626	87	2 7
Lime	1,997	23	0 7
Manure	60	1	0 0
Horseshoeing	3,653	42	1.3
Insurance	3,603	41	1.3
Sawing lumber	1,186	13	0 4
Machinery (new)	9,457	107	3 3
Repairs on machinery	3,934	45	1.4
Machinery hired	575	7	0 2
Filling silo	1,572	18	0 6
Threshing	1,426	16	0 5
Coal, oil, gasoline, etc	3,273	37	1 1
Twine	651	7	0 2
Farm share of upkeep and operation of automobile.	7,026	80	2 5
Ice, and sawdust for ice	412	5	0 2
Hauling milk	1,057	12	0.4
Milk bottles, cans, strainers	865	10	0 3
Cow-tester, acid, fees.	1,191	14	0.4
Registration fees	435	5	0 2
Grass seed	3,730	42	1 [illegible]
Other seeds, plants, trees	5,061	58	1 8
Spray materials	556	6	0 2
Stamps, stationery, for farm use	222	[illegible]	0 1
Taxes, general	11,447	130	4 [illegible]
Taxes, school	5,467	62	1 9
Veterinary, medicine	1,618	18	0 6
Electricity and carbide	1,134	13	0 4
Water system	542	6	0 2
Telephone, farm use	1,278	15	0.5
All other farm expenses	4,407	50	1 6
Total (except cash rent and new buildings)	$283,461	$3,221	100 0
Cash rent	1,250	...	.....
New buildings.	3,467	39	. .
Operator	(3,034)	. .	. .
Landlord	(433)	. .	...
Total	$288,178	.	...
Livestock purchased	39,921	454	......
Operator	(36,842)	.. . .	...
Landlord	(3,079)	. ..	.. ..
Total (except cash rent)	$326,849	$3,714	....

Feed represents a larger proportion of the total of farm expenses in this area than in the Tully and Homer area, where also cash crops were grown in combination with the system of producing milk for shipping stations. In the alfalfa region previously reported, cattle and horse feed made up the smallest proportion of the total farm expenses of all the areas producing

market milk, and in the Norwich and Oxford area, where the system of dairying was straight milk without cash crops, the purchased cattle and horse feed represented a larger proportion of the total farm expenses than in any other area

LABOR INCOMES

The net farm income for this area, or the difference between the farm receipts and the farm expenses, was $836 in 1922. The interest on the capital of $16,080, at 5 per cent, was $804, leaving an average labor income of $32 for the 88 farm operators for the year 1922. The average labor income for the same year in an area producing cash crops and having alfalfa hay for roughage, as reported in Bulletin 438 of this experiment station, was $4.

The labor income as found by recalculating the milk receipts at the pool prices paid by the Dairymen's League Cooperative Association was –$30, in contrast to + $32.

The net income can be expressed in terms of interest on the investment by deducting from the farm income of $836 the average value of the operator's time, which was $1017, or –$181 per farm. Therefore, if the operators had received from the net farm earnings what they calculated their time was worth, they would have received no interest on their investment.

The average cash living costs for the 88 families were $367 for food, $179 for clothes, and $193 for all other items; a total of $739 per farm, or $62 per month. In the preceding year the cash living costs were $816 per farm, or $68 per month. They were thus 9.4 per cent less in 1922 than in the preceding year. The net farm income in 1922 was 27.3 per cent less than in the preceding year.

COSTS AND RETURNS IN PRODUCING MILK

The following grouping is used for the purpose of considering the costs in producing milk: concentrates, succulent feed, dry forage, pasture, bedding, labor, hauling milk, use of buildings, use of equipment, interest, depreciation on cows, bull service, and miscellaneous charges. The returns are for milk and milk products, calves born during the year, manure, and miscellaneous returns.

COSTS

Concentrates

The average value of home-grown grain in 1922 on the 88 farms was $33.09 per ton, and of purchased concentrates $42.48 per ton (table 15). The average cost per ton of all concentrates used on these farms was 10 per cent higher in 1922 than in 1921. The price of milk, however, was only 2 cents per 100 pounds, or 1 per cent, higher than in the preceding year. This, together with the fact that crops did not sell for as much money as in the preceding year, made it more difficult for these farmers to operate their business successfully in 1922. A smaller proportion of the concentrates were home-grown in 1922 than in 1921. Of the total concentrates used by horses, 68 per cent in 1922 and 59 per cent in 1921, were home-grown.

The cost for concentrates per 100 pounds of milk was 70 cents in 1922 and 73 cents in the preceding year. The cost per cow was $41.44 in 1922 and $41.85 in 1921.

Of the dairymen who follow the same system as to when they have their cows freshen, those who feed heavily in winter also use more grain supplementary to pasture. Also, more grain is used in the summer in large herds than in small herds; probably because the pastures are more overstocked on large farms.

The use of a moderate amount of grain supplementary to pasture pays better than does too much or none. The right amount varies with the abundance of pasturage, with price conditions, and according to whether the cows are dry or in milk when on pasture. In 1921, with 60 per cent of the milk produced in the winter, the farmers who fed more than 400 pounds of grain supplementary to pasture with an average of 715 pounds per cow, also fed 243 more pounds of grain per cow in the winter than did farmers who fed no grain in summer. The total was 958 pounds more of grain for the year. These farmers obtained 1422 more pounds of milk per cow for the year. The daily production of milk was about 4 pounds more per cow, both in summer and in winter, than when no grain was used with pasture. With grain and milk each at about $2 per hundred pounds, this amount of grain supplementary to pasture did not pay. Dairymen who used up to 400 pounds per cow produced milk cheapest, and made the highest labor incomes on the farm, as a whole.

With feeding as with other farm practices, each farmer must determine the most profitable practice for his own conditions. The results in this study indicate that probably less than half of the dairymen were feeding in the summer the amount of grain that would pay the best. The other half were feeding either too little or too much. The kind of feed also is important.

Succulent feed

The average value of corn silage was $5.09 per ton in 1922, and $5.61 per ton in the preceding year. The average value of all succulent feed, except skimmilk, was $5.16 per ton. (Table 16.)

The charges for succulent feed in 1922 were $22.10 per cow, or 37 cents per 100 pounds of milk. In 1921 they were $24.47 per cow, or 42 cents per 100 pounds of milk.

A total of 9.6 tons of harvested cabbage and cabbage refuse was fed per farm, in addition to the refuse pastured by cattle. This, with corn silage, constituted the chief kinds of succulent feed given to dairy animals.

Dry forage

Of the total dry forage used by cows in 1922, 10.4 per cent was alfalfa hay.

The average value of all dry forage used by cattle and horses in 1922 was $12.39 per ton. In 1921 it was $14.96 per ton, or 17.2 per cent more.

The charges for dry forage used in producing milk in 1922 were $26.48 per cow, or 45 cents per 100 pounds of milk. In 1921 they were $26.48 per cow, or 46 cents per 100 pounds of milk.

The data for 1922 for dry forage used are given in table 17.

TABLE 15. CONCENTRATES USED BY 1934 COWS, 866 HEIFERS, 87 HERD BULLS, AND 318 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (cwt.)	Average price per ton	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value
Home-grown:													
Corn for grain	330	$36 00	$ 594			195	$369	45	$ 76			90	$ 149
Oats	3,991	31 95	6,376			275	493	112	186	5	$11	3,599	5,686
Oats and barley	1,552	34 24	2,657			339	583	66	118			1,147	1,956
Oats and peas	94	35 96	169			74	133					20	36
Oats, peas, and barley	90	24 89	112									90	112
Barley	154	38 18	294			47	94	60	120			47	80
Buckwheat	24	40 00	48			24	48						
Winter wheat	90	48 00	216			90	216						
Total home-grown	6,325	$33 09	$10,466			1,044	$1,936	283	$500	5	$11	4,993	$8,019
Purchased:													
Cornmeal	946	$39 20	$ 1,851	38	$ 75	726	$ 1,426	100	$ 193	26	$ 50	56	$ 110
Hominy*	2,680	38.28	5,120	552	1,037	1,447	2,800	438	820	83	158	148	290
Corn and oats	140	39 57	277									140	277
Cracked corn	15	40.00	30									15	30
Whole corn	249	39 20	488									249	488
Whole oats	271	37 27	505									271	505
Ground oats*	2,178	40 19	4,377	191	379	1,079	2,207	262	517	54	108	585	1,152
Ground corn and oats	360	37 28	671			60	96	5	10			295	565
Ground corn, oats, and barley	120	38 00	228					40	76			80	152
Ground barley	20	37.00	37			20	37						
Buckwheat middlings	42	35 24	74			38	67	4	7				
Molasses	511	30 06	768	50	95	448	656	12	15	1	2		
Molasses feed	60	40.00	120			60	120						
Wheat bran	3,094	32 43	5,017	451	730	1,752	2,874	679	1,047	69	120	143	246
Wheat feed	815	39 85	1,624	64	128	532	1,069	199	390	20	37		
Wheat middlings	18	37 78	34	9	17	2	4	4	7	3	6		
Gluten feed*	5,477	41 45	11,351	1,126	2,279	3,999	8,335	265	576	63	121		
Cottonseed meal	264	52 95	699	39	106	210	552	10	27	5	14		
Oilmeal*	1,593	52 74	4,201	205	553	990	2,602	333	802	32	88	26	78
Calf meal	39	83 59	163					39	163				
Schumacher	90	38 89	175									90	175
Madison Balanced Dairy Ration	7,667	45.19	17,323	747	1,785	6,579	14,791	272	594	69	153		
Tom Gaines' Balanced Ration	7,601	44 45	16,802	1,492	3 303	5,809	12,925	234	519	66	145		
Armour's Dairy Feed	2,393	42.37	5,070	317	663	1,921	4,074	130	279	15	34	10	20
G. L. F. Milkmaker	1,477	45 74	3,378	215	514	1,210	2,718	41	91	11	25		
Madison Coop. Milk Maker	720	47 00	1,602	188	442	490	1,151	22	52	20	47		
Stock feed	677	39 00	1,320	324	632			90	175			263	513
Summit	570	48.21	1,371	100	246	390	930	70	172	10	26		

Armour's Stock Ration	570	40 42	1,152	150	300	350	710	55	112	15	30		
Cornell Ration Milk Maker	300	42 00	630			300	630						
Brownie	269	43 12	580	37	82	112	246	99	208	21	44		
Cornell Mixture	160	44 00	352			160	352						
Red Brand Tioga Dairy Feed	149	44 03	328	37	82	112	246						
Beet pulp	120	49 50	297	72	168	45	121	3	8				
Distillers' dried grains	104	51.15	266			104	266						
Cornell Dairy Feed	100	48 00	240			93	223	7	17				
Ryan & Leland Balanced Ration	86	40 00	172			86	172						
3 M	80	50 00	200			80	200						
Schumacher's Molasses Feed	62	40 00	124					40	80	12	24	10	$20
Vim	60	43 00	129					60	129				
Climax	60	45 00	135			60	135						
Crawford's Stock Feed	30	34 00	51			30	51						
Crawford's Balanced Ration	20	47.00	47			20	47						
Cloverleaf Dairy Feed	20	40 00	40			20	40						
Unicorn	10	56 00	28			10	28						
Schumacher's Sugared Ration	5	36 00	9			5	9						
Kinds not found	670	48 00	1,608			660	1,584			10	24		
Total purchased*	42,962	$42 48	$91,259	6,404	$13,616	30,009	$64,584	3,513	$7,086	605	$1,256	2,381	$4,621
Total concentrates*	49,287	$41 28	$101,725	6,404	$13,616	31,053	$66,520	3,796	$7,586	610	$1,267	7,374	$12,640

* Bull calves to be sold were fed: 12 hundredweight of hominy, valued at $24; 7 hundredweight of ground oats, valued at $14; 24 hundredweight of gluten feed, valued at $40; and 7 hundredweight of oilmeal, valued at $18.

TABLE 16. SUCCULENT FEED USED BY 1934 COWS, 866 HEIFERS, AND 87 HERD BULLS

Kind of feed	Total			Cows				Heifers		Herd bulls	
				Pasture period		Winter period					
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:											
Corn silage	7,577.0	$5.09	$38,558	199.0	$1,013	6,496.1	$33,063	785.5	$3,996	96.4	$486
Corn silage, 1921	336.0	5.09	1,711	319.0	1,624	17.0	87	...	...	...	...
Millet silage	5.0	10.00	50	...	...	5.0	50	...	...	...	...
Corn	92.0	5.86	539	92.0	539	...	...	...	...	...	...
Potatoes	9.9	12.02	119	...	...	9.9	119	...	...	...	...
Cabbage	601.5	4.56	2,741	37.0	191	564.5	2,550	...	...	...	...
Cabbage refuse	239.0	3.47	829	89.0	297	150.0	532	...	...	...	...
Beets and mangels	37.3	18.50	690	...	...	36.0	670	1.3	20	...	...
Peavines	36.5	9.07	331	22.5	199	13.0	124	1.0	8	...	...
Oats	2.5	4.00	10	2.5	10	...	...	...	...	...	...
Oats and peas	39.0	11.05	431	39.0	431	...	...	...	...	...	...
Oats and buckwheat	5.0	4.00	20	5.0	20	...	...	...	...	...	...
Buckwheat	7.0	3.57	25	7.0	25	...	...	...	...	...	...
Millet	13.0	6.77	88	13.0	88	...	...	...	...	...	...
Sudan grass, first cutting	13.0	3.46	45	13.0	45	...	...	...	...	...	...
Sudan grass, second cutting	6.0	2.00	12	6.0	12	...	...	...	...	...	...
Rye	2.0	7.00	14	2.0	14	...	...	...	...	...	...
Alfalfa, second cutting	30.0	9.00	270	30.0	270	...	...	...	...	...	...
Alfalfa, third cutting	23.0	6.30	145	23.0	145	...	...	...	...	...	...
Rowen	51.0	9.53	486	41.0	336	10.0	150	...	...	...	...
Total home-grown	9,125.7	$5.16	$47,114	940.0	$5,259	7,301.5	$37,345	787.8	$4,024	96.4	$486
Purchased:											
Corn silage	33.5	$4.09	$137	...	...	33.5	$137	...	...	...	...
Cabbage	3.0	2.00	6	...	...	3.0	6	...	...	...	...
Total purchased	36.5	$3.92	$143	...	...	36.5	$143	...	...	...	...
Total succulent feed	9,162.2	$5.16	$47,257	940.0	$5,259	7,338.0	$37,488	787.8	$4,024	96.4	$486

TABLE 17. DRY FORAGE USED BY 1934 COWS, 866 HEIFERS, 87 HERD BULLS, AND 318 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Alfalfa, first cutting	294.0	$13.85	$4,072	8.0	$96	258.0	$3,594	25.0	$346	1.0	$12	2.0	$24
Alfalfa, second cutting	133.0	14.34	1,907			117.0	1,670	15.0	222	1.0	15		
Alfalfa, third cutting	40.0	15.62	625			27.0	399	12.0	204			1.0	22
Mixed hay (clover)	1,565.0	12.54	19,631	4.0	50	1,355.0	16,924	120.5	1,543	34.5	455	51.0	659
Mixed hay (other)	2,071.0	12.35	25,582	22.5	288	1,250.0	15,398	266.5	3,344	82.5	1,021	449.5	5,531
Rowen	185.0	12.68	2,345	6.0	75	143.0	1,858	34.0	388	2.0	24		
Timothy	924.0	12.81	11,841			529.2	6,836	117.5	1,562	23.3	312	254.0	3,131
Oat hay	54.0	13.39	723	7.0	76	46.0	632			1.0	15		
Oat and pea hay	63.0	13.62	858			52.0	704	4.0	72			7.0	82
Oat and barley hay	8.0	10.00	80			2.0	20	6.0	60				
Millet hay	18.0	10.44	188			16.0	164	2.0	24				
Millet and sudan grass	19.0	11.58	220			19.0	220						
Sudan grass	6.0	9.67	58	1.0	10	5.0	48						
Total hay	5,380.0	$12.66	$68,130	48.5	$595	3,819.2	$48,467	602.5	$7,765	145.3	$1,854	764.5	$9,449
Oat straw	31.5	$6.86	$216			21.0	$138	4.0	$29			6.5	$49
Buckwheat straw	2.0	6.00	12			2.0	12						
Corn stover	65.5	4.64	304	7.0	$10	48.5	244	10.0	50				
Corn fodder	51.0	5.65	288	12.0	54	38.5	231			0.5	$3		
Peavines, cured	6.0	10.00	60	4.0	40	2.0	20						
Total straw, stover, etc	156.0	$5.64	$880	23.0	$104	112.0	$645	14.0	$79	0.5	$3	6.5	$49
Total home-grown	5,536.0	$12.47	$69,010	71.5	$699	3,931.2	$49,112	616.5	$7,844	145.8	$1,857	771.0	$9,498
Purchased:													
Alfalfa, first cutting	23.0	$7.91	$182			23.0	$182						
Mixed hay (clover)	1.0	12.00	12			1.0	12						
Mixed hay (other)	102.8	10.57	1,087	2.0	$20	97.3	1,016					3.5	$51
Timothy	24.1	10.75	259			14.1	141	4.0	$48			6.0	70
Corn stover	10.0	3.30	33			10.0	33						
Total purchased	160.9	$9.78	$1,573	2.0	$20	145.4	$1,384	4.0	$48			9.5	$121
Total dry forage	5,696.9	$12.39	$70,583	73.5	$719	4,076.6	$50,496	620.5	$7,892	145.8	$1,857	780.5	$9,619

Quantities of feed used

The quantities of feed used per cow and per unit of product for the year covered by this study are shown in table 18:

TABLE 18. AMOUNTS OF FEED USED PER COW AND PER UNIT OF PRODUCT, FOR THE YEAR, IN POUNDS

	Per cent of cows freshening from September to December, inclusive						All herds	
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent			
	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced
Concentrates	1,530	28.2	1,898	31.1	2,215	31.5	1,937	30.7
Silage	4,967	91.6	7,573	123.9	8,385	119.3	7,300	115.9
Other succulent feed	1,092	20.1	982	16.1	1,641	23.4	1,255	19.9
Dry forage	4,944	91.2	4,173	68.3	4,038	57.5	4,292	68.1
Days of pasture	162	3.0	161	2.6	159	2.3	161	2.6
Acres of pasture	2.8	.	3.0		3.2	.	3.0	. .

The average amounts of feed used per cow were: concentrates, 1937 pounds; succulent feed, 8561 pounds; dry forage, 4292 pounds. The number of days spent on pasture was 161, and the average acreage pastured was 3 acres per animal.

Less concentrates, the same amount of succulent feed, and more hay, were used per cow and per unit of product in 1922 than in 1921.

The quantities of feed used per cow per day and per unit of product in the winter period, and per unit of product during the pasture period, are given in table 19:

TABLE 19. AMOUNTS OF FEED USED PER COW PER DAY, AND PER UNIT OF PRODUCT, IN PASTURE AND WINTER PERIODS, IN POUNDS

	Per cent of cows freshening from September to December, inclusive						All herds		All herds (pasture period) per 100 pounds of milk produced in pasture period
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent				
	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	
Concentrates	5.8	46.5	7.5	45.4	9.4	41.3	7.9	43.6	12.6
Silage	23.5	189.0	33.6	203.2	38.1	167.5	33.2	183.9	20.4
Other succulent feed	2.1	16.7	3.5	21.5	5.6	24.6	4.0	22.2	16.6
Dry forage	24.0	192.9	20.2	122.4	19.1	83.8	20.7	114.5	2.9
Days of pasture	. .	. . .	.	. .	. .	. . .	.	. ....	6.1
Acres of pasture	. ..	.	.	.	. .	...	. ...	.. ...	0.12

A total of 43.6 pounds of grain, 206.1 pounds of succulent feed, and 114.5 pounds of dry forage, was used per 100 pounds of milk produced in the winter period. The feeding of concentrates and silage was heavier in this region than in any of the other areas studied which did not receive a price premium for low bacteria count. The reason for this, probably, is the large proportion of purebred animals in the herds.

Pasture

The average date of turning the cattle out to pasture in the spring was May 15, and of stabling in the fall October 22, giving a pasture season of 161 days. This gives the same length of pasture season as in the preceding year.

The average charge for the use of pasture in 1922 was $7.30 per cow, or 12 cents per 100 pounds of milk. This charge included $5.71 per cow for the use of pasture, $1.32 per cow for the use of meadows after the hay was removed, and 27 cents per cow for bait on the cabbage fields after the crop was harvested The data are given in table 20:

TABLE 20. PASTURE CHARGES ON 88 FARMS

	Number of animal units pastured	Charge for pasture	
		Total	Per animal unit
Cows	1,908	$11,047	$5 79
Heifers	310 5	2,184	7 03
Bulls	35	189	5 40
Horses	106	588	5 55
Meadows pastured after hay was removed	1,153	$2,565	$2 22
Cabbage bait	313	$515	$1 64

Bedding

The kind of bedding used, the amounts, and the charges, are given in table 21. The charge for bedding amounted to $1.49 per cow, or 3 cents per 100 pounds of milk

TABLE 21. BEDDING USED ON 88 FARMS

Kind of bedding	Cows		Heifers		Herd bulls		Horses	
	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:								
Oat straw	259 5	$1,702	55 7	$353	2 0	$10	74 8	$472
Old oat straw	3 0	28					1 0	10
Oat and barley straw	60 0	433	13 5	92	2 0	18	22 5	165
Oat and pea straw	1 0	4	1 0	4	1 0	4	1 0	4
Oat hay	8 5	46			0 5	2	2 0	12
Oat, pea, and barley straw	3 0	30					2 0	20
Barley straw	18 6	116	10 0	78			6 9	51
Barley and buckwheat straw			1 0	5	1 0	5		
Buckwheat straw	4 0	12						
Wheat straw	20 1	137	1 0	5			7 9	59
Total	377 7	$2,508	82 2	$537	6 5	$39	118 1	$793
Purchased.								
Oat straw	20 3	$181	0 5	$2			0 5	$3
Wheat straw	4 0	8					2 0	4
Buckwheat straw	5.5	13						
Sawdust	17 0	160	0 5	5				
Shavings	1 0	12						
Total	47 8	$374	1 0	$7			2 5	$7
Total bedding	425.5	$2,882	83 2	$544	6 5	$39	120 6	$800

Labor

The charges for the direct human labor on cows in 1922 averaged $33.54 per cow, or 57 cents per 100 pounds of milk. The labor charge in the preceding year was $36.79 per cow, or 64 cents per 100 pounds of milk. The average rates per hour were: human labor, 26 cents; horse labor, 18 cents. The variations in rates per hour asked by the operators, and in rates paid for hired labor, are given in table 22

TABLE 22. VARIATIONS IN RATES PER HOUR FOR OPERATORS AND HIRED MEN

Rate per hour (cents)	Operators		Hired men	
	Number of farms	Per cent	Number of farms	Per cent
8	...	...	1	1.7
10	1	1.1	1	1.7
12	...	...	1	1.7
13	...	...	1	1.8
14	...	...	1	1.8
15	...	...	2	3.5
16	...	...	3	5.3
17	4	4.6	4	7.0
18	1	1.1	6	10.5
19	...	...	2	3.5
20	2	2.3	11	19.3
21	...	...	2	3.5
22	3	3.4	5	8.8
23	3	3.4	5	8.8
24	1	1.1	3	5.3
25	11	12.5	4	7.0
26	1	1.1	2	3.5
27	6	6.8	...	...
28	4	4.6	...	...
30	9	10.2	3	5.3
31	2	2.3	...	...
33	16	18.2	...	...
34	3	3.4	...	...
35	5	5.7	...	...
36	1	1.1	...	...
38	1	1.1	...	...
40	4	4.6	...	...
42	5	5.7	...	...
47	1	1.1	...	...
50	2	2.3	...	...
60	2	2.3	...	...
Total	88	100.0	57	100.0

The average rate at which the operator's time was charged was 31 cents per hour, and that of the hired men's time was 20 cents per hour. The labor required in the pasture and winter periods in the production of milk is shown in table 23.

TABLE 23. LABOR REQUIRED IN PASTURE AND WINTER PERIODS

	Hours in pasture period				Hours in winter period				Total hours			
	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value
Human labor for cows:												
Hauling milk....	9,728	5 0	0.2	$ 2,463	13,372	6.9	0 2	$ 3,388	23,100	11.9	0.2	$ 5,851
Milking..	50,482	26 1	1.0	13,056	69,749	36.1	1.0	18,029	120,231	62.2	1.0	31,085
Other human labor.........	17,803	9 2	0 3	4,764	108,706	56.2	1.5	29,020	126,509	65 4	1.0	33,784
Total.........	78,013	40 3	1.5	$20,283	191,827	99.2	2 7	$50,437	269,840	139 5	2.2	$70,720
Total except hauling milk.	68,285	35 3	1 3	$17,820	178,455	92.3	2.5	$47,049	246,740	127 6	2.0	$64,869
Horse labor for cows:												
Hauling milk....	10,481	5 4	0.2	$1,921	20,880	10.8	0 3	$3,830	31,361	16.2	0 3	$5,751
Other horse labor.	1,560	0 8	0.0	273	15,561	8.1	0 2	2,727	17,121	8 9	0 1	3,000
Total....	12,041	6 2	0 2	$2,194	36,441	18 9	0 5	$6,557	48,482	25.1	0 4	$8,751
Human labor for heifers..........	652	..	...	$181	9,410	...	...	$2,603	10,062	......	...	$2,784
Horse labor for heifers.........	160	.....	.....	$30	2,585	......	....	$479	2,745	.....	.....	$509

Hauling milk

The average distance from the farms to the milk plants was 2.6 miles. The charges for hauling milk are given in table 24. The charges amounted to 12 cents per 100 pounds of milk in 1922, and 15 cents in 1921. The charges per cow were $7.35 in 1922 and $8.96 in 1921. Most of the farmers hauled their own milk.

TABLE 24. CHARGES FOR HAULING AND DELIVERY TO THE MILK STATION, 114,223 HUNDREDWEIGHT OF MILK

	Pasture period	Winter period	Total
Human labor:			
Number of farms	75	76	......
Hours	9,728	13,372	23,100
Value	$2,463	$3,388	$5,851
Horse labor:			
Number of farms	57	74	...
Hours	10,481	20,880	31,361
Value	$1,921	$3,830	$5,751
Value of total human and horse labor	$4,384	$7,218	$11,602
Hauling hired:			
Number of farms	..	.	15
Cash paid	. .	. . .	$1,057
Use of automobiles and trucks:			
Number of farms	. .	. .	16
Value	..	.	$1,702
Total charges for hauling milk	. . .	....	$14,361
Amount received for hauling milk	.....	. .	$144
Total net cost of hauling milk	. .	. . . .	$14,217
Net cost per 100 pounds, of hauling milk	. . .	. ..	$0.12

Use of buildings

The average charge for the use of buildings was $5.72 per cow, or 10 cents per 100 pounds of milk. The data are given in table 25:

TABLE 25. CHARGES FOR USE OF BUILDINGS ON 88 FARMS

Value of barns and other buildings used for dairy cattle	$183,625
Interest at 5 per cent	$9,181
Taxes	3,175
Insurance	836
Repairs	822
Total	$14,014
Charged to:	
Cows	$11,067
Heifers	2,417
Herd bulls	530
Total	$14,014

Use of equipment

The charge for use of equipment was $1.50 per cow, or 3 cents per 100 pounds of milk. The average value of equipment was $267 per farm. The interest, repairs, purchases of new equipment, and depreciation on equipment, amounted to $40 per farm.

Interest

The charge for interest averaged $7.22 per cow, or 12 cents per 100 pounds of milk. The interest charge was 12 cents per 100 pounds of milk also in the preceding year. There has been very little variation from year to year in the interest charge per unit of product, except when values of animals have decidedly fallen.

Depreciation on cows

The average value of grade cows was $90 per head, or $5 more per head than in 1921. The value of purebred cows was $174 per head as against $176 per head in the preceding year. The average value of all cows in 1922 was $120 per head, and in 1921 it was $113, or $7 per head less. The depreciation on cows was $4.94 per head, or 8 cents per 100 pounds of milk sold. The average of the estimates as to the increase in the market value of cows during the year was, for grades, $3.21 per head, and for purebreds, $14.68 per head The market for fresh cows was slightly stronger in the year 1922 than in 1921, but did not increase so much as it had decreased in the preceding year.

The number of cows that were sold, that were eaten on farms, and that died, for each 100 cows in the inventory, was 28.4 in 1922 and 22.2 in 1921. In 1922, 26 per cent of the average number of cows on hand were sold; in 1921 only 20 per cent of the average number of cows were sold. The harder times in 1922 were the cause of the larger number of farmers selling cows in order to get money, than in 1921.

Bull service

The average cost of keeping 87 herd bulls was $99 per cattle unit. There was a net depreciation on bulls of $19.94. The average value of herd bulls kept was $175. The charge for bull service was $4.21 per cow, or 7 cents per 100 pounds of milk. The data are given in table 26:

TABLE 26. COST OF BULL SERVICE ON 88 FARMS

	Total		Per cattle unit	
	Amount	Value	Amount	Value
Costs:				
Concentrates	610 cwt.	$1,267	745 lbs.	$15 47
Succulent feed	96 4 tons	486	2,354 lbs.	5 93
Dry forage	145.8 tons	1,857	3,560 lbs.	22 67
Whole milk	9,745 lbs.	256	119 lbs.	3.13
Pasture	...	189	...	2 31
Bedding	6 5 tons	39	159 lbs.	0 48
Interest	...	870	..	10.62

TABLE 26 (*concluded*)

	Total		Per cattle unit	
	Amount	Value	Amount	Value
Costs (*concluded*):				
Depreciation (net)		$1,633		$ 19.94
Use of buildings		530		6.47
All other costs		2,187		26.70
Total		$9,314		$113.72
Returns:				
Manure	655 tons	$1,204	8 tons	$14.70
Total		$1,204		$14.70
Cost of keeping own herd bulls		$8,110		$99.02
Service hired		$38		
Net cost of bull service		$8,148		
Net cost per cow		$4.21		
Number of herd bulls		86 7		
Cattle units of herd bulls		81 9		

Miscellaneous charges

Miscellaneous expenses for cows are given in table 27. They amounted to $3.97 per cow, or 7 cents per 100 pounds of milk. The most important items of miscellaneous expenses are oil and gasoline to operate the milking machine, veterinary fees and medicines, salt, ice, expenses for testing cows, and electricity and carbide for lights.

TABLE 27. MISCELLANEOUS EXPENSES FOR COWS, 88 FARMS

Item	Charge
Advertising	$ 31
Salt	742
Grinding feed	144
Electricity and carbide	575
Water system	15
Insurance	903
Coal, oil, gasoline	1,530
Farm share of upkeep and operation of automobile	325
Freight and express	25
Ice, and sawdust for ice	410
Cow-tester, acid	899
Spray materials	281
Stamps and stationery	21
Telephone	276
Veterinary fees and medicines	1,348
Other farm expense	155
Total	$7,680
Total per cow	$3.97
Total per 100 pounds of milk sold wholesale	$0.07

RETURNS

Milk and milk products

The data for milk and its products used on the farm are given in table 28:

TABLE 28. RETURNS FROM MILK PRODUCTS SOLD AND MILK AND ITS PRODUCTS USED ON THE FARM, 1934 COWS

	Number of farms	Number of pounds of product	Total value
Milk products sold:			
Butter	1	45	$ 25
Milk sold retail	2	7,080	276
Milk used:			
Operators' families	88	290,037	$5,726
Hired men's families	15	26,556	532
Landlords' families	1	1,570	36
Poultry	1	100	3
Total milk used	88	318,263	$6,297
Milk products used:			
Butter, family use	4	437	$185
Skimmilk, hogs	1	3,500	7
Total milk and its products used, except that fed to cattle	88	322,200	$6,489
Milk fed:			
Heifers	69	368,235	$9,106
Veals	11	48,004	1,066
Bull calves to be sold	2	7,300	170
Bull calves to be kept for herd bulls	9	9,745	256
Total milk fed to cattle	70	433,284	$10,598
Milk products fed:			
Skimmilk, heifers	3	9,680	50
Total milk and its products fed to cattle	71	442,964	$10,648
Equivalent, in pounds of milk, of milk and its products used	......	765,164	......
Pounds of fat in milk retailed, milk products sold, and milk and its products used	......	25,761	....

The average amount of milk used by the operator's family was 3296 pounds. Of the total milk, 94 per cent was sold and 6 per cent was used on the farm. The average production per cow was 6305 pounds of milk, containing 211 pounds of butterfat. The yield was practically the same as in the preceding year.

The production per cow in the stabling period averaged 3681 pounds, or 18 pounds per cow per day. In the pasture period the production was 2624 pounds per cow, or 16.3 pounds per cow per day.

The returns for all milk not sold wholesale averaged $9.01 per cow, or 15 cents per 100 pounds of milk sold wholesale.

Calves born during the year

A total of 1877 calves were born during the year, of which 107, or 5.7 per cent, were born dead (table 29)

TABLE 29. NUMBER OF CALVES BORN DURING THE YEAR, AND THEIR VALUE AT BIRTH

	Number of farms	Number of calves	Per cent	Value	Average value at birth
Heifers to be raised or sold:					
Purebred	34	217	12 3	$6,756	$31 13
Grade	47	163	9 2	809	4 96
Bulls to be kept:					
Purebred	11	11	0 6	357	32 45
Grade	4	4	0 2	26	6 50
Bulls sold or to be sold:					
Purebred	6	13	0 7	815	62 69
Grade	1	5	0 3	25	5 00
Calves vealed or to be vealed	81	1,216	68 7	2,923	2 40
Calves deaconed	20	141	8 0	..	..
Deacon hides	14	(107)	.	234	2 19
Total calves born alive*	87	1,770	100 0	$11,945	$6 75
Live calves per 100 cows		92		.	..
Calves born dead	36	107		..	..
Dead calf hides	2	(13)		6	...
Total credited to cows		.	.	$11,951	....
Cows that would not breed	18	24	.	...	.....
Cows with unsound quarters	59	112	.		.....

*The total number of calves exceeds the number of cows calving, by one, because of twins.

Of the cows on hand at the end of the year, 1 2 per cent failed to breed and 5.7 per cent had unsound quarters. The average weight of cows was 1003 pounds. The average number of weeks during which they were dry was 8.3. The value at birth of grade heifers was $4.96 each; of purebred heifers, $31.13 each; of calves for vealing, $2.40 each; and of all live calves born during the year, $6.75 each, or 32 cents more than in the preceding year. Of the total live calves born during the year, 21 5 per cent were heifers raised, 1.8 per cent were bulls to be raised, and 76.7 per cent were vealed or deaconed. The proportion of calves vealed or deaconed was slightly higher than in the preceding year.

The returns from calves and calf hides sold amounted to $6.18 per cow, or 10 cents per 100 pounds of milk sold.

Manure

The average value of manure per ton in the barnyard was $1.84, as compared with $1.97 in the preceding year. The amount recovered from cows averaged 7.9 tons, valued at $14.47 per cow, or 25 cents per 100 pounds of milk, which was the same value per unit of product as in the preceding year. The data are given in table 30.

TABLE 30. MANURE RECOVERED FROM CATTLE AND HORSES

	All stock	Cows	Heifers	Herd bulls	Bull calves to be sold	Veals	Horses
Manure recovered (tons)	22,075	15,210	3,533	655	56	23	2,598
Value at $1.84 per ton at the barnyard	$40,619	$27,988	$6,499	$1,204	$104	$42	$4,782

Miscellaneous returns

The various miscellaneous items credited to cows averaged 33 cents per cow, or 1 cent per 100 pounds of milk. They consisted chiefly of feed bags.

SUMMARY OF COSTS AND RETURNS

The costs and returns of the dairy enterprise, expressed per cow and per 100 pounds of milk, are given in table 31 (page 34).

The net cow cost of producing milk was $2.35 per 100 pounds. The herd cost was only 2 cents per 100 pounds higher. This slight difference between the cow cost and the herd cost indicates that the loss on heifers was not so high as in the preceding year on these farms

With concentrates at $41.28, silage at $5.09, and dry forage at $12.39, per ton, and labor at 26 cents per hour, the average loss was $13.35 per cow, or 23 cents per 100 pounds of milk sold This loss was about one-half that for the preceding year The chief reason was the fact that hay was more plentiful and cheaper in 1921, and labor was charged at 1 cent per hour less. While a balance of returns against costs shows a loss in producing milk on these farms, the returns from cows exceeded all other costs except labor by 16.6 cents per hour for each hour of time put in for the dairy enterprise. In the preceding year these farmers received 9.3 cents per hour for each hour spent for the dairy enterprise.

Variations in the cost of producing milk are shown in table 32. Of these 88 farmers, 54 produced milk at less than $2 50 per 100 pounds, while on 22 farms the cost was more than $3 per 100 pounds. The lowest cost was $1.26 per 100 pounds, and the highest was $5.16 per 100 pounds

TABLE 31. SUMMARY OF COSTS AND RETURNS, 1934 COWS

	Per cow	Per 100 pounds of milk sold wholesale
Costs:		
Concentrates	$41.44	$0.70
Succulent feed	22.10	0.37
Dry forage	26.48	0.45
Pasture	7.30	0.12
Bedding	1.49	0.03
Human labor	33 54	0.57
Horse labor	1.55	0.03
Hauling milk	7 35	0.12
Use of buildings	5.72	0.10
Use of equipment	1.50	0.03
Interest on cows	7 22	0.12
Depreciation on cows (net)	4 94	0.08
Bull service	4.21	0.07
Miscellaneous	3.97	0.07
Total costs	$168 81	$2.86
Returns:		
Milk sold wholesale		
Cash	$118.13	$2.00
Certificates of indebtedness	7 34	0.12
Milk products sold, and milk retailed	0.15	....
Milk and milk products used, except that fed to cattle	3.35	0.06
Milk and milk products fed to cattle	5 51	0.09
Calves and calf hides	6.18	0.10
Manure	14.47	0.25
Miscellaneous	0.33	0.01
Total returns	$155.46	$2.63
Loss	$13.35	$0.23
Cow cost of producing milk	$138.82	$2.35
Herd cost of producing milk	....	$2.37
Cow cost per pound of butterfat	....	$0.70

TABLE 32. VARIATIONS IN THE COST OF PRODUCING MILK

Per cent of cows freshening from September to December, inclusive	Number of farms with cow cost, per 100 pounds of milk sold wholesale, as designated					
	Less than $2.50	$2.50 to $3.00	$3.01 to $3.50	$3.51 to $4.00	$4.01 to $4.50	More than $4.50
Less than 25 per cent	14	1	1	1	.....	1
From 25 to 50 per cent	16	6	9	5	1	.....
More than 50 per cent	24	5	2	2	.....	.....
All herds	54	12	12	8	1	1

COST OF RAISING HEIFERS

The average age at which heifers freshened for the first time was 27.2 months. The variations in the age are shown in table 33. The average value of heifers was $77.34 for grades, $151.35 for purebreds, and $120.62 for all heifers. This was slightly higher for grades, and lower for purebreds, than in the preceding year. The average value of all heifers was $8 higher than in the preceding year.

TABLE 33. AGE OF HEIFERS FRESHENING FOR THE FIRST TIME, AND THEIR VALUE

Age (months)	Number of heifers	Value
18	6	$ 540
19	1	50
22	9	1,125
24	70	7,380
25	11	1,775
26	25	3,070
27	105	14,820
28	3	375
29	8	570
30	78	8,925
32	2	150
34	1	75
35	2	150
36	8	650
48	4	310
Total	333	$39,965

The average cost of raising heifers to two years of age was $97.29 (table 34). It was higher in the herds with a larger proportion of cows freshening in the fall, than in the herds with more spring-fresh cows. Since heifers do not freshen at exactly two years of age, this cost should be increased in order to determine the cost of raising up to the time of freshening.

Altho the cost of raising heifers is equal to the value of cows, the abundance of good pasture, the large proportion of purebreds, and the lack of a price medium for the milk, make it desirable for the farmer to raise a large proportion of his heifers. Even with the depressed market for purebred cattle, heifers can be raised for less than the average selling price of purebred cows. The price for grade cows, however, is less than the cost of raising heifers.

TABLE 34. COST OF RAISING HEIFERS

	Per cent of cows freshening from September to December, inclusive						All herds		
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent		Total		Amount per cattle unit
	Amount*	Value	Amount*	Value	Amount*	Value	Amount	Value	
Costs:									
Whole milk	42,047	$921	175,616	$4,606	150,572	$3,579	368,235 pounds	$9,106	850 pounds
Skimmilk, farm			7,180	25	2,500	25	9,680 pounds	50	22 pounds
Grain	366	763	1,770	3,523	1,660	3,300	3,796 cwt.	7,586	877 pounds
Silage	88.5	450	416	2,116	281	1,430	785.5 tons	3,996	3,628 pounds
Other succulent feed			0.8	14	1.5	14	2.3 tons	28	11 pounds
Hay	69	809	293	3,948	244.5	3,056	606.5 tons	7,813	2,801 pounds
Other dry forage	10	50	1	5	3	24	14 tons	79	65 pounds
Pasture		309		945		930		2,184	
Bedding	5	29	45	305	33.2	210	83.2 tons	544	384 pounds
Human labor	1,678	403	4,727	1,373	3,657	1,008	10,062 hours	2,784	23 hours
Horse labor	315	60	1,156	213	1,274	236	2,745 hours	509	6 hours
Use of buildings		248		1,149		1,020		2,417	
Use of equipment		71		267		244		582	
Interest on stock		271		1,676		1,659		3,606	
Miscellaneous		45		384		350		779	
Total costs		$4,429		$20,549		$17,085		$42,063	
Returns:									
Manure	353	$ 650	1,551	$ 2,854	1,629	$ 2,995	3,533 tons	$ 6,499	8.2 tons
Appreciation		2,808		15,305		14,509		32,622	
Total returns		$3,458		$18,159		$17,504		$39,121	
Difference (gain or loss)		−$971		−$2,390		+$419		−$2,942	
Value at birth, plus purchases, less sales and hides and those eaten		$198		$4,897		$1,467		$6,562	
Cost of raising a heifer to two years of age:									
Total		$3,977		$22,592		$15,557		$ 42,126	
Per cattle unit		$73.51		$112.01		$87.79		$97.29	
Number of cattle units	54.1		201.7		177.2		433.0		

* The same unit of quantity is used in this column as is used in the column for total amounts for all herds.

FALL OR SPRING FRESHENING

An average of 45.7 per cent of the cows freshened from September to December, inclusive, but in the smaller dairies only 10.9 per cent, and in the larger winter dairies 70.7 per cent, of the cows freshened during this period. The data are given in table 35. The ages of the cows are given in table 36.

TABLE 35. COWS FRESHENING BY MONTHS

	All herds		Per cent of cows freshening from September to December, inclusive					
			Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1922:								
May	116	6.2	59	15.2	37	4.8	20	2.8
June	48	2.6	20	5.2	26	3.4	2	0.2
July	31	1.6	9	2.3	19	2.5	3	0.4
August	59	3.1	9	2.3	27	3.5	23	3.2
September	212	11.3	4	1.0	71	9.2	137	19.1
October	227	12.1	9	2.3	88	11.4	130	18.1
November	209	11.1	11	2.9	70	9.1	128	17.8
December	210	11.2	18	4.7	79	10.3	113	15.7
1923:								
January	161	8.6	31	8.0	69	9.0	61	8.5
February	131	7.0	39	10.1	64	8.3	28	3.9
March	249	13.3	91	23.5	122	15.8	36	5.0
April	223	11.9	87	22.5	98	12.7	38	5.3
Total	1,876	100.0	387	100.0	770	100.0	719	100.0

TABLE 36. AGES OF 1968 COWS ON HAND APRIL 30, 1923

Age (years)	Per cent of cows freshening from September to December, inclusive						All herds	
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
2– 3	46	10.5	146	18.7	147	19.6	339	17.2
3– 4	35	8.0	167	21.4	131	17.5	333	16.9
4– 5	115	26.3	131	16.8	128	17.1	374	19.0
5– 6	75	17.1	110	14.1	116	15.5	301	15.3
6– 7	56	12.8	92	11.8	87	11.6	235	12.0
7– 8	46	10.5	56	7.1	60	8.0	162	8.2
8– 9	33	7.5	39	5.0	38	5.1	110	5.6
9–10	12	2.7	16	2.0	20	2.7	48	2.4
More than 10	20	4.6	24	3.1	22	2.9	66	3.4
Total	438	100.0	781	100.0	749	100.0	1,968	100.0

The average number of cows was approximately the same in the summer dairies as in the winter dairies. The average capital per farm was slightly higher for the farmers following the winter system (table 37). The production per cow was 1606 pounds of milk greater, the cows were larger, the cost of milk per 100 pounds was 19 cents less, and the average labor income per farm was $673 more, on the farms having a large proportion of the cows freshening in the fall. In the preceding year the labor income averaged $725 more on farms with a large proportion of fall-freshening cows. It is apparent that it pays best to follow the winter system in this region. The average returns per hour of labor, after all other costs were met, were 13.3 cents in the summer dairies and 28.4 cents, or 15.1 cents per hour higher, in the winter dairies. In the preceding year the returns were 10.5 cents per hour higher in the winter than in the summer dairies, on the same farms.

TABLE 37. RELATION OF SEASON OF FRESHENING TO VARIOUS FACTORS

	Per cent of cows freshening from September to December, inclusive			All herds
	Less than 5 per cent	From 25 to 50 per cent	More than 50 per cent	
Number of farms	18	37	33	88
Number of cows	426	778	730	1,934
Cows per farm	23.7	21.0	22.1	22.0
Average capital per farm	$15,047	$15,522	$17,270	$16,080
Average labor income per farm	−$231	−$207	+$442	+$32
Pounds of milk produced per farm	128,301	128,527	155,445	138,575
Pounds of milk produced per cow	5,421	6,112	7,027	6,305
Weight of cows (pounds)	988	985	1,032	1,003
Per cent of milk sold from November to April	39.0	48.0	60.2	51.4
Butterfat test of milk (per cent)	3.4	3.3	3.3	3.3
Per cent of cows freshening from September to December, inclusive	10.9	40.0	70.7	45.7
Cost of milk per 100 pounds	$2.32	$2.60	$2.13	$2.35
Price received per 100 pounds	$2.05	$2.10	$2.18	$2.12

The variations in the labor incomes on the 88 farms are shown in table 38:

TABLE 38. VARIATIONS IN LABOR INCOMES ON 88 FARMS

Per cent of cows freshening from September to December, inclusive	Number of farms making labor incomes as designated				
	Minus $500 or more	Minus $499 to 0	Plus $1 to plus $500	Plus $501 to $1000	More than $1000
Less than 25 per cent	3	10	3	2	......
From 25 to 50 per cent	14	6	7	5	5
More than 50 per cent	5	2	8	8	10
All herds	22	18	18	15	15

Of the 88 farmers, 40 failed to make interest, 33 made labor incomes of from $1 to $1000, and 15 made labor incomes of more than $1000. This is a smaller proportion of farmers making labor incomes of $1000 than in the preceding year in the same region.

The detailed statement of the costs and returns per cow and per 100 pounds of milk for the summer and winter dairies is given in table 39:

TABLE 39. COSTS AND RETURNS FOR THE THREE SEASONAL GROUPS

	Per cent of cows freshening from September to December, inclusive					
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale
Costs:						
Concentrates	$33.94	$0.66	$40.19	$0.71	$47.13	$0.71
Succulent feed	16.60	0.32	21.74	0.38	25 70	0 39
Dry forage	27 62	0.54	27.10	0.48	25.16	0.38
Pasture	6.71	0.13	7.80	0.14	7.13	0.11
Bedding	0.72	0.01	1.96	0 03	1.44	0 02
Human labor	28.54	0.56	35.22	0.62	34.67	0.52
Horse labor	1.09	0.02	1.49	0.03	1.88	0.03
Hauling milk	5.61	0.11	7.86	0.14	7.83	0.12
Use of buildings	4.58	0.09	5 94	0.10	6 16	0.09
Use of equipment	1.07	0.02	1.51	0.03	1.72	0.03
Interest on cows	5.86	0.11	7.95	0.14	7.22	0.11
Depreciation on cows (net)	3 68	0.07	10.23	0.18	0.04	....
Bull service	2 11	0.04	4.51	0.08	5.12	0 08
Miscellaneous	2.83	0.06	4.69	0 08	3.87	0.06
Total costs	$140 96	$2.74	$178.19	$3.14	$175.07	$2 65
Returns:						
Milk sold wholesale:						
Cash	$99 24	$1.93	$111 70	$1.97	$136.01	$2.06
Certificates of indebtedness	6.38	0.12	7.06	0.13	8.19	0.12
Milk products sold, and milk retailed	....	.....	0.26	...	0.13	......
Milk and milk products used, except that fed to cattle	2.69	0.05	3.66	0.06	3.42	0.05
Milk and milk products fed to cattle	2.88	0 06	6.60	0.12	5.87	0.09
Calves and calf hides	2.43	0.05	5.89	0.11	8 68	0.13
Manure	13.32	0.26	14.25	0.25	15.37	0.24
Miscellaneous	0.06	......	0.18	......	0.64	0.01
Total returns	$127.00	$2.47	$149.60	$2.64	$178.31	$2.70
Gain	......	......	......	......	$3.24	$0.05
Loss	$13 96	$0.27	$28.59	$0.50	......	......
Returns per hour of human labor above all other costs	......	$0.133	......	$0.071	......	$0.284

FERTILITY MAINTENANCE

The uses of fertilizer and lime, in 1922, are given in tables 40 and 41. Of the fertilizer used, 25.9 per cent was acid phosphate, 13.3 per cent was 2–8–2, 23 per cent was 2–8–10, and 8.6 per cent was 4–8–4; a total of 70.8 per cent of all the fertilizer purchased. The remaining 29.2 per cent was chiefly commercial fertilizer of slightly different compositions. The average cost of 219.8 tons of purchased fertilizer was $34.69 per ton.

The pounds of commercial fertilizer used per acre to which fertilizer was applied, averaged: for corn for grain, 236 pounds; for corn for the silo, 277 pounds; for oats alone, 270 pounds; for potatoes, 649 pounds; for cabbage, 565 pounds; and for market peas, 331 pounds.

A total of 371.6 tons of lime, or 4.2 tons per farm, was used, of which 98.9 per cent was ground limestone. Practically the same amount of lime was used on these farms as in the preceding year. The average application of lime, and the average cost, also are shown in table 40. The average cost of ground limestone per ton was $5.36.

TABLE 40. SUMMARY OF FERTILIZER AND LIME USED ON 88 FARMS

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre	Cost of fertilizer
For corn for grain:					
0–5–10	1	2	750	375	$12
1–8–4	1	2	400	200	7
2–8–10	1	1	100	100	2
3–10–0	1	2	400	200	13
Total fertilizer	4	7	1,650	236	$34
For corn for fodder:					
2–8–10	1	2	200	100	$4
Total fertilizer	1	2	200	100	$4
For corn for the silo:					
Nitrate of soda	2	13	3,000	231	$101
Acid phosphate	7	83.5	18,300	219	228
Bone meal	1	12	1,000	83	17
1–8–2	2	13	6,000	462	85
1–8–4	2	12	3,700	308	68
2–8–2	6	49	15,800	322	278
2–8–3	2	22	4,400	200	88
2–8–4	4	30 5	7,460	245	156
2–8–5	1	9	3,600	400	58
2–8–6	1	5	1,250	250	16
2–8–7	1	5	2,500	500	51
2–8–10	9	77	21,650	281	413
3–9–2	1	16	4,000	250	72
4–8–4	1	6	2,000	333	35
4–8–7	1	6	3,000	500	56
Kinds not found	2	11	4,800	436	48
Total fertilizer	39	370 0	102,460	277	$1,770
Ground limestone	4	16	23,000	1,438	$99

TABLE 40 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre	Cost of fertilizer
For oats:					
Nitrate of soda	1	12	1,600	133	$ 50
Acid phosphate	13	140	37,475	268	395
0–5–10	1	15	5,625	375	90
1–8–2	1	10	2,000	200	27
1–8–4	4	16	3,933	246	75
2–8–2	5	39	12,620	324	225
2–8–7	2	13	4,430	341	88
2–8–10	7	53	11,700	221	215
4–8–4	4	35	10,435	298	226
Total fertilizer	37	333	89,818	270	$1,391
Hydrated lime	1	4	8,000	2,000	$28
Ground limestone	17	155	293,500	1,894	$791
For oats and barley:					
Acid phosphate	1	8	1,600	200	$20
1–8–4	1	8	1,200	150	20
2–8–2	1	10	2,000	200	30
2–8–3	1	12	1,000	83	17
Total fertilizer	4	38	5,800	153	$87
Ground limestone	1	6	10,200	1,700	$25
For oats and peas:					
Acid phosphate	1	6	1,200	200	$12
2–8–2	2	9	3,000	333	53
2–8–6	1	2	600	300	8
Total fertilizer	4	17	4,800	282	$73
Ground limestone	2	6	12,000	2,000	$27
For barley:					
0–10–4	1	7	4,000	571	$50
2–8–6	1	3	900	300	13
Total fertilizer	2	10	4,900	490	$63
Ground limestone	4	28	40,000	1,429	$84
For buckwheat:					
2–8–2	1	5	1,280	256	$29
2–8–7	1	1	370	370	7
Total fertilizer	2	6	1,650	275	$36
For wheat:					
Acid phosphate	1	10	3,000	300	$52
2–8–3	1	4	1,200	300	23
2–8–10	2	12	1,800	150	33
Total fertilizer	4	26	6,000	231	$108
Ground limestone	3	20	19,500	975	$69

TABLE 40 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre	Cost of fertilizer
For alfalfa:					
1–8–4	1	4	1,000	250	$18
Total fertilizer	1	4	1,000	250	$18
Ground limestone	7	16	32,600	2,038	$92
For mixed hay, clover:					
Ground limestone	10	88	128,400	1,459	$312
For mixed hay, other:					
Ground limestone	3	23 2	16,000	690	$90
For sudan grass:					
Acid phosphate	1	3	525	175	$6
Total fertilizer	1	3	525	175	$6
Ground limestone	1	1 5	3,000	2,000	$5
For new seeding:					
Ground limestone	3	29	53,000	1,828	$111
For beets:					
Acid phosphate	1	1	600	600	$5
Total fertilizer	1	1	600	600	$5
For potatoes:					
Acid phosphate	6	12	6,700	558	$ 87
2–8–2	5	9.5	3,300	347	60
2–8–3	2	5	1,300	260	22
2–8–4	6	8.8	5,490	624	114
2–8–5	1	1	400	400	6
2–8–7	2	2.5	2,300	920	47
2–8–10	18	32	22,450	702	485
3–8–4	1	3	2,000	667	24
3–8–10	1	1	2,000	2,000	38
3–10–0	1	0.2	200	1,000	7
4–8–4	7	14	11,615	830	243
Total fertilizer	50	89.0	57,755	649	$1,133
Ground limestone	1	1	2,000	2,000	$7
For market peas:					
Acid phosphate	9	62	18,275	295	$285
0–2–10	1	5	1,000	200	18
0–5–10	1	15	5,625	375	90
1–8–4	1	2	600	300	11
2–8–2	4	16.5	5,100	309	103
2–8–4	2	6	2,400	400	41
2–8–10	9	53.5	17,300	323	346
4–8–4	3	3.5	3,550	1,014	81
Kinds not found	1	3	1,200	400	22
Total fertilizer	30	166.5	55,050	331	$997
Ground limestone	3	11	20,000	1,818	$57

TABLE 40 (*concluded*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre	Cost of fertilizer
For cabbage:					
Nitrate of soda	1	5	3,000	600	$ 35
Acid phosphate	12	40.5	26,100	644	295
1–8–2	1	2	1,000	500	13
1–8–4	2	4	1,267	317	20
2–8–2	7	19.5	15,100	774	345
2–8–3	1	4	1,000	250	19
2–8–4	4	9.5	5,900	621	122
2–8–7	2	4	2,400	600	49
2–8–10	15	54.5	25,850	474	492
3–8–4	2	15	6,000	400	88
3–10–0	1	2	400	200	13
4–8–2	1	3	1,500	500	33
4–8–4	8	18.5	10,025	542	209
4–8–6	1	5	4,000	800	100
4–8–7	1	1	1,500	1,500	35
Kinds not found	1	2	2,000	1,000	26
Total fertilizer	58	189.5	107,042	565	$1,894
Ground limestone	12	52.5	82,100	1,564	$200
For garden:					
2–8–4	1	0.5	400	800	$7
Total fertilizer	1	0.5	400	800	$7

TABLE 41. Total Fertilizer and Lime Used

Forms of fertilizer and lime	Pounds used	Per cent of total pounds	Value	Average price per ton
Fertilizer:				
Nitrate of soda	7,600	1.7	$ 186	$48.95
Acid phosphate	113,775	25.9	1,385	24.34
Bone meal	1,000	0.2	17	34.00
0–2–10	1,000	0.2	18	36.00
0–5–10	12,000	2.7	192	32.00
0–10–4	4,000	0.9	50	25.00
1–8–2	9,000	2.1	125	27.78
1–8–4	12,100	2.8	219	36.20
2–8–2	58,200	13.3	1,123	38.59
2–8–3	8,900	2.0	169	37.98
2–8–4	21,650	4.9	440	40.65
2–8–5	4,000	0.9	64	32.00
2–8–6	2,750	0.6	37	26.91
2–8–7	12,000	2.7	242	40.33
2–8–10	101,050	23.0	1,990	39.39
3–8–4	8,000	1.8	112	28.00
3–8–10	2,000	0.5	38	38.00
3–9–2	4,000	0.9	72	36.00

TABLE 41 (*concluded*)

Forms of fertilizer and lime	Pounds used	Per cent of total pounds	Value	Average price per ton
Fertilizer (*concluded*).				
3-10-0	1,000	0 2	$ 33	$66 00
4-8-2	1,500	0 4	33	44 00
4-8-4	37,625	8 6	794	42 21
4-8-6.	4,000	0 9	100	50 00
4-8-7	4,500	1 0	91	40 44
Kinds not found	8,000	1 8	96	24 00
Total fertilizer	439,650	100 0	$7,626	$34 69
Lime				
Ground limestone	735,300	98 9	$1,969	$5 36
Hydrated lime	8,000	1 1	28	7.00
Total lime	743,300	100 0	$1,997	$5 37

The average rate of spreading manure for all crops was 11 5 tons per acre, as compared with 12 tons in the preceding year. The rate for corn for the silo was 14 6 tons per acre, for new seeding 12 1 tons, for old meadows 7.3 tons, for cabbage 13 1 tons, and for potatoes 13.4 tons. The rates of spreading were much the same as in 1921. The detailed data are given in table 42·

TABLE 42. USE OF MANURE ON 88 FARMS

Crop	Number of farms using	Acres manured	Tons applied	Tons per acre manured	Per cent of tons applied
Corn for grain	8	13 5	235	17 4	1.1
Corn for the silo	71	544 0	7,932	14 6	36.1
Corn fed green	3	3 0	50	16 7	0.2
Corn for fodder	3	10 0	160	16 0	0.7
Oats	6	59 0	534	9.1	2.4
Oats, peas, and barley	1	10 0	100	10 0	0.5
Barley	1	7 0	70	10 0	0.3
Hay, first year	56	504.5	6,092	12.1	27.7
Hay, old meadows	42	544 0	3,989	7 3	18.1
Alfalfa	3	10.0	92	9.2	0.4
Cabbage	45	140.8	1,843	13 1	8.4
Potatoes	27	34 0	455	13.4	2 1
Peas	6	15 5	115	7.4	0.5
Beets	2	2 0	55	27.5	0.2
Garden	1	1 0	10	10.0	0.1
Pasture	2	13.0	260	20 0	1.2
Total		1,911 3	21,992	11 5	100.0
Not used	....	.	140	....	......

The balance of the plant-food constituents removed from and added to the soil is given in table 43:

TABLE 43. FERTILITY-BALANCE STATEMENT FOR 88 FARMS

	Pounds of plant food				Tons of organic matter
	N	P_2O_5	K_2O	CaO	
By removal in crops grown:					
Total	278,584	90,148	326,305	129,434	....
Per acre of crops, excluding orchard (5,156.8 acres)	54	17	63	25	..
By addition:					
Nodule fixation	97,450		..	..	..
Commercial fertilizer	6,895	43,466	18,731	59,611	.
Lime	.	.		417,528	. .
Seed	3,664	1,155	1,745	334	74 1
Straw, hay, etc., for bedding	7,402	2,638	17,979	5,094	545.6
Dry forage fed*	94,339	31,226	118,238	49,903	2,236 8
Succulent feed fed*	33,818	17,456	42,208	17,960	917 3
Concentrates fed*	83,080	22,095	10,502	6,456	877 5
Amount added (total) †	326,648	118,036	209,403	556,886	4,651 3
Per acre	63	23	41	108	0 90
Removal less addition per acre †	+9	+6	−22	+83	.

* Feed supplementary to pasture excluded.
† When it is considered that 60 per cent of the N, 70 per cent of the P_2O_5, 60 per cent of the K_2O, 60 per cent of the CaO, and 45 per cent of the dry matter, in feed, is returned in manure.

The fertility-balance statement shows much the same condition as in 1921, except that more nitrogen was added in the form of commercial fertilizer, and more lime was used.

LABOR DISTRIBUTION

The percentage of labor spent on cattle in the respective months ranged from 28.9 in July to 78.3 in December (table 44). The method used in

TABLE 44. SUMMARY OF WORK UNITS ON 88 FARMS

	Cattle	Other live-stock	Cultivated crops	Grain crops and annual hay crops	Hay	Other crops	Miscellaneous	Total	Per cent on cattle	Per cent for each month
January	2,852	452	118	9	63	3	204	3,701	77.1	7 2
February	2,595	445	87	1	66	4	188	3,386	76 6	6 6
March	2,795	468	97	7	53	12	361	3,793	73 7	7 4
April	2,652	498	968	297	83	21	100	4,619	57 4	9 0
May	2,424	492	1,297	250	63	12	1	4,539	53 4	8 8
June	1,997	435	1,793	31	245	6	1	4,508	44 3	8.8
July	1,939	413	2,816	48	1,463	3	18	6,700	28.9	13 0
August	1,882	399	381	592	857	7	18	4,136	45.5	8 1
September	1,882	369	821	349	518	22	44	4,005	47.0	7 8
October	2,168	393	1,623	107	46	65	13	4,415	49.1	8.6
November	2,481	407	865	87	23	11	14	3,888	63.8	7 6
December	2,852	445	204	32	95	2	11	3,641	78.3	7.1
Total including labor on horses	28,519	5,216	11,070	1,810	3,575	168	973	51,331	....	100 0
Total excluding labor on horses	28,519	1,394	11,070	1,810	3,575	168	973	47,509	..	...
Per cent	60.0	2.9	23.3	3.8	7.5	0.4	2 1	100.0	. ...	.....

calculating the distribution of labor has been described in preceding bulletins of this series. Of the total labor for the year, 60 per cent was spent on cattle, 2.9 per cent on other livestock, 23.3 per cent on cultivated crops,

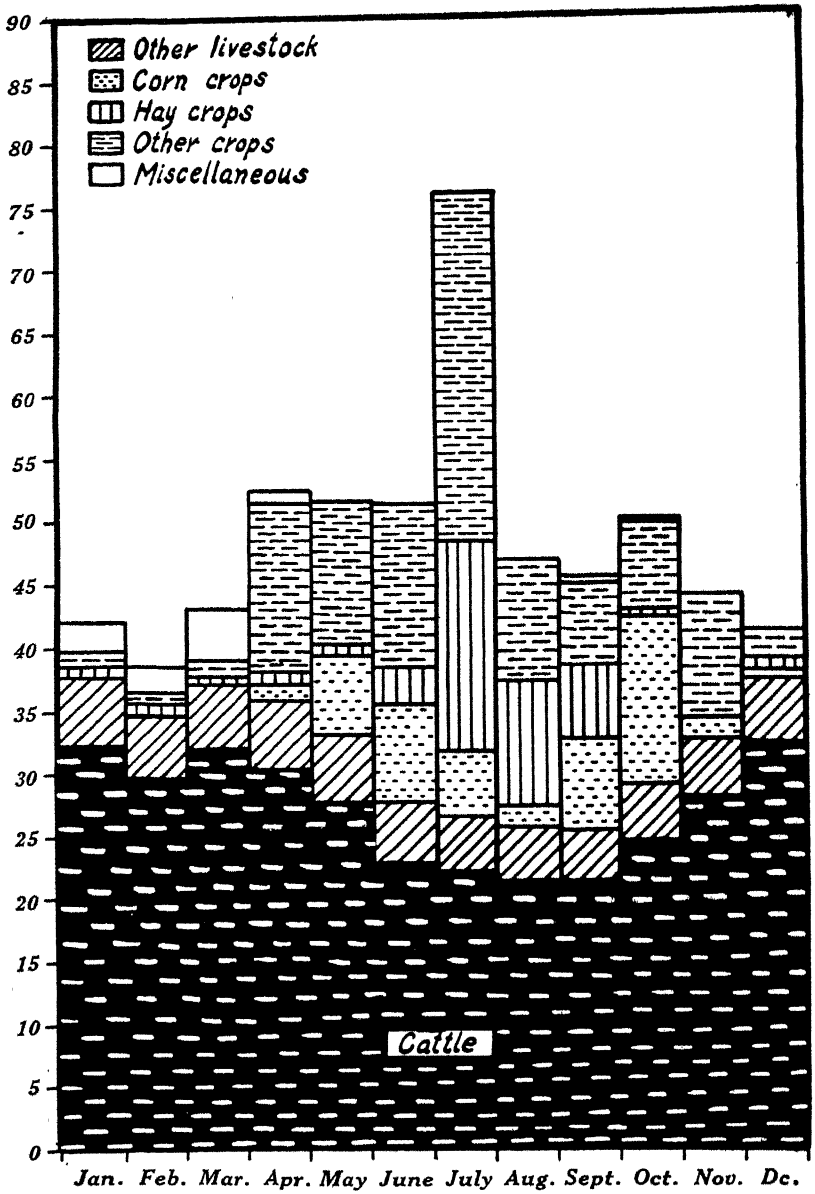

FIGURE 1. DISTRIBUTION OF MAN LABOR ON 88 FARMS IN 1922

3.8 per cent on grain and annual hay crops, 7.5 per cent on hay, and the remaining 2.5 per cent on miscellaneous enterprises. The productive work units for all crops and animal labor, except that for horses, averaged 247 per man and 64 per work animal. The average number of men for the 88 farms was 2.19, and of work animals 3.6. The average acres of crops per farm was 26.9 per man and 16.3 per work animal.

Of the total labor, 6.6 per cent was performed in February and 13 per cent in July. This indicates that twice as much productive work was performed in July as in February. The distribution by months is shown in figure 1.

PRICES OF PEAS

The wholesale prices of peas for market in New York City have been published and discussed in Bulletin 441 of this experiment station. The prices for the crop year 1922 and the five-years average are plotted in figure 2. The yield in 1922 averaged 95 bushels per acre, and the price $1.76

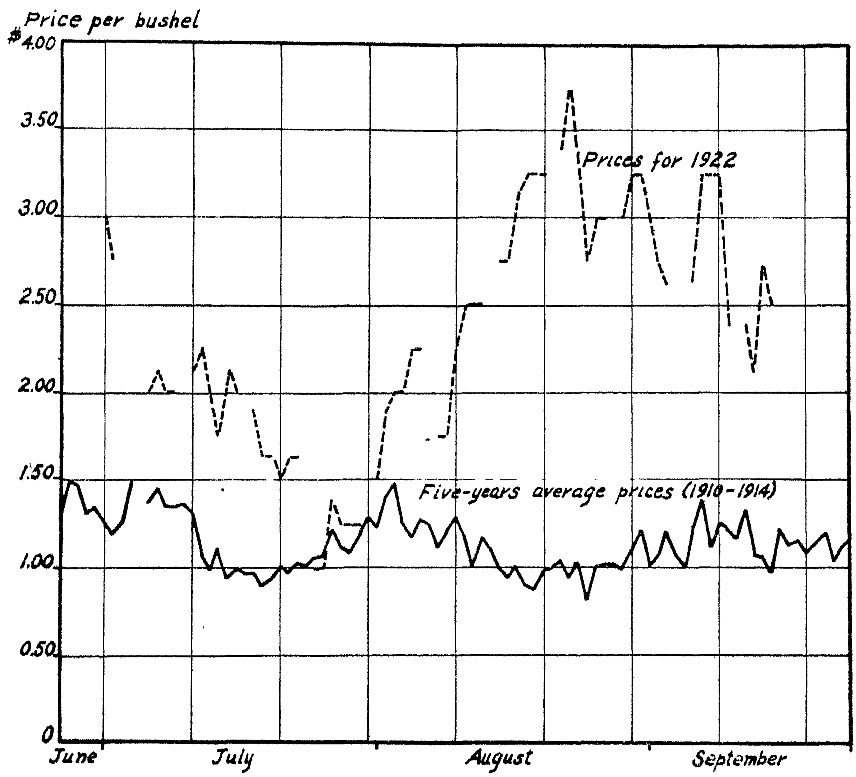

FIGURE 2. WHOLESALE PRICES OF PEAS IN NEW YORK CITY IN 1922 COMPARED WITH THE FIVE-YEARS AVERAGE

per bushel, this being a yield of 51 bushels less per acre, and a price 9 cents less per bushel, than in 1921. The prices ranged very high late in the season, but very few peas were sold at these prices. The gross income from market peas in 1922 was $168 per acre.

SUMMARY OF AVERAGES

ımary of the important business factors for the farms for the crop 2 is given in table 45:

45. SUMMARY FOR COMPARING INDIVIDUAL FARMS WITH THE AVERAGE FOR 88 FARMS

	Average for 88 farms	Individual farms
cord, ending April 30	1923	....
....	Chenango	....
ome	+$32	....
ome if pool prices had been received	−$30	....
siness:		
oductive man-work units	540	....
res of crops	59 0	....
res pastured (woods in equivalent of open pasture)	67.0	....
ımber of cows, average	22	....
ımber of men, including operator	2.19	....
ıpital	$16,080	....
ındredweight of milk sold per farm	1,299	....
ıimal units per farm:		
Including work animals	32.8	....
Excluding work animals	29.2	....
usiness:		
rerage miles to milk station	2.6	....
r cent of total productive man-work units on:		
Cattle	60.0	....
Cultivated crops	23.3	....
Grain crops	3.8	....
Hay	7.5	....
All else	5.4	....
ıtal productive man-work units on farm per acre of crops	9.2	....
r cent of capital in:		
Real estate	67	....
Livestock	26	....
Equipment and supplies	7	....
r cent of cows freshening from September to December, inclusive	45.7	....
r cent of milk sold during:		
May, June, July	28.7	....
August, September, October	19.9	....
November, December, January	24.1	....
February, March, April	27.3	....
rerage weight of cows (pounds)	1,003	....
rerage weeks cows are dry	8.3	....
r cent of cows less than four years old	34.1	....
r cent of cows replaced	28.4	....
r cent of cows added that were raised at home	53.1	....
r cent of cows added that were purchased	46.9	....
rerage age of heifers when freshening for first time (months)	27.2	....
rade of milk	Grade B	....
r cent of milk produced which is sold	93.7	....
r cent of milk kept at farm	6.3	....
f business:		
sture acres per animal unit pastured	2.5	....
res of crops per animal unit	1.8	....

TABLE 45 (*continued*)

	Average for 88 farms	Individual farms
Year of record, ending April 30	1923	....
County	Chenango	....
Balance of business (*concluded*):		
27. Manure per acre of crops (tons)	4.3	....
28. Manure applied per acre of crops receiving manure (tons)	11.5	....
29. Value of purchased fertilizer per acre of crops	$1.47	....
30. Labor distribution (good, fair, poor)	Good	....
31. Important sources of income, and receipts from each, per farm:		
Milk	$2,761	....
Appreciation on cattle*	$395	....
Crops sold	$592	....
32. Elements removed per acre by crops (pounds):		
Nitrogen	54	....
Phosphoric acid	17	....
Potash	63	....
Lime (CaO)	25	....
33. Elements added per acre (pounds):		
Nitrogen †	63	....
Phosphoric acid	23	....
Potash	41	....
Lime (CaO)	108	....
34. Per cent of receipts from crops	13.0	....
Rates of production:		
35. Crop index, all crops (based on average yields for New York State)	126.2	....
36. Crop index:		
Corn for the silo	178.1	....
Oats (threshed)	86.9	....
Hay	123.6	....
37. Pounds of milk produced per cow	6,305	....
38. Pounds of milk sold per cow	5,910	....
39. Pounds of milk produced per dollar invested in cows	55	....
40. Value of milk and its products sold per cow	$126	....
41. Appreciation on cattle per cattle unit	$14.19	....
Labor efficiency:		
42. Productive man-work units per man	247	....
43. Acres of crops per man	26.9	....
44. Animal units, except work animals, per man	13.3	....
45. Productive horse-work units per work animal	64	....
46. Acres of crops per work animal	16.3	....
47. Labor returns per man	$404	....
48. Labor returns per man-work unit	$1.64	....
49. Per cent of farms using milking machines	55	....
50. Per cent of months machines are used	86	....
51. Hundredweight of milk produced per man	633	....
Human labor:		
Hours per cow per year:		
52. Milking	62	....
53. Hauling milk	12	....
54. Other labor	66	....
Hours per 100 pounds of milk produced:		
55. Pasture season	1.5	....

* Includes value of calves born during the year.
† No account is taken of nitrogen added by free fixation and by precipitation.

TABLE 45 (*continued*)

	Average for 88 farms	Individual farms
Year of record, ending April 30	1923	....
County	Chenango	....
Human labor (*concluded*):		
Hours per 100 pounds of milk produced (*concluded*):		
56. Winter	2.7	....
57. For year	2.2	....
Capital efficiency:		
58. Value of crop land per acre ‡	....	....
59. Value of pasture land per acre ‡	....	....
60. Value of woodland per acre ‡	....	....
61. Value of houses per farm ‡	....	....
62. Value of cattle barns per farm ‡	....	....
63. Value of other buildings per farm ‡	....	....
64. Per cent of real-estate capital in buildings ‡	....	....
65. Per cent of real-estate capital in land ‡	....	....
66. Value of machinery and equipment per acre of crops	$18.58	....
Feeding efficiency:		
Feed:		
Per cow per year:		
67. Concentrates (pounds)	1,937	....
68. Silage (pounds)	7,306	....
69. Other succulent feed (pounds)	1,255	....
70. Dry forage (pounds)	4,292	....
71. Protein (digestible pounds) ‡	....	....
72. Energy (therms) ‡	....	....
73. Days of pasture	161	....
Per cow per day during winter:		
74. Concentrates (pounds)	7.9	....
75. Silage (pounds)	33.2	....
76. Other succulent feed (pounds)	4 0	....
77. Dry forage (pounds)	20 7	....
78. Protein (digestible pounds) ‡	....	....
79. Energy (therms) ‡	....	....
80. Protein-energy ratio ‡	....	....
Per 100 pounds of milk produced in pasture period:		
81. Days of pasture	6.1	....
82. Concentrates (pounds)	12.6	....
83. Silage and other succulent feed (pounds)	37.0	....
84. Dry forage (pounds)	2.9	....
Per 100 pounds of milk produced in winter period:		
85. Concentrates (pounds)	43.6	....
86. Silage (pounds)	183.9	....
87. Other succulent feed (pounds)	22.2	....
88. Dry forage (pounds)	114.5	....
89. Protein (digestible pounds) ‡	....	....
90. Energy (therms) ‡	....	....
Per 100 pounds of milk produced thru the year:		
91. Concentrates (pounds)	30.7	....
92. Silage (pounds)	115.9	....
93. Other succulent feed (pounds)	19.9	....
94. Dry forage (pounds)	68.1	....
95. Protein (digestible pounds) ‡	....	....
96. Energy (therms) ‡	....	....

‡ The data for these items are not computed for this study, but the numbers and items are included here in order to facilitate comparison with corresponding tables in other publications of this series.

TABLE 45 (*concluded*)

	Average for 88 farms	Individual farms
Year of record, ending April 30	1923	....
County	Chenango	....
Costs and returns for cows:		
97. Total costs per cow	$169	....
98. Returns, exclusive of milk sold wholesale	$30	....
99. Cost of milk sold per cow	$139	....
100. Value of milk sold, cash per cow	$118	....
101. Certificates of indebtedness, per cow	$8	....
102. Gain or loss per cow (loss)	$13	....
103. Price received per 100 pounds of milk	$2.12	....
104. Cost of producing 100 pounds of milk	$2.35	....
105. Loss per 100 pounds of milk	$0.23	....
Cost of raising a heifer:		
106. To two years of age	$97	....
107. To age of freshening (approximate)	$109	....

Some of the data for each farm are given in table 46, so that comparisons of one farm with another, and exercises in studying the relationship of various factors to the financial returns of the farms, can be given in teaching if desired.

TABLE 46 (concluded)

		Acres ... crops		Average	Man			Current		Labor	Cow cost	Pounds
380...	43	22.5	10.0	$ 6,858	1.5	$1,470	$ 284	$1,660	$ 315	$ 315	$2.38	6,812
397...	58	25.4	18.5	14,389	1.9	2,907	1,445	4,279	1,268	577	3.01	6,091
406...	58	32.0	13 0	6,992	2.2	1,702	1,293	2,586	342	342	2.22	6,537
414. .	60	26 0	20 5	11,641	2 2	3,045	.....	4,373	− 177	− 568	2.92	6,504
417...	63	32.5	16.5	8,866	1.5	3,036	269	2,065	1,599	1,216	2 03	7,542
454 ..	65	27.0	12.5	9,960	1.1	1,402	......	1,120	− 106	− 106	2.72	5,697
395	70	41 0	20.5	14,162	1.9	2,117	39	2,685	−1,422	−1,422	2.61	5,364
430.	76	24.0	14.0	11,105	1.8	1,701	90	2,056	−1,395	−1,395	3 03	6,004
433..	84	38 5	14 5	15,368	2 1	1,157	350	1,491	− 154	− 154	1.78	4,196
375.	90	26.0	16 0	11,184	1 8	1,440	227	2,271	−1,787	−1,787	4 40	4,893
394..	91	36.0	16.5	10,130	2.0	1,552	315	2,305	−1,102	−1,102	3 44	5,488
393.	93	44.5	16.0	14,964	2 0	2,004	638	2,690	892	892	2.45	6,709
362..	100	59.0	13.0	8,510	1 7	1,544	798	1,335	924	924	2.58	5,979
371.	100	47.0	16 5	13,070	1 4	1,877	648	1,634	888	888	1 91	6,048
376 ..	100	38.5	16 0	8,546	1.2	3,317	7	3,011	1,239	1,239	1 77	9,491
410..	100	29 0	12.0	10,160	1.2	1,152	60	1,032	− 73	− 153	3 09	4,759
438..	100	39.0	14 5	11,936	2 0	1,992	1,221	2,175	481	481	1 89	6,838
456..	100	51.0	14.0	6,650	2.2	1,533	225	1,633	101	101	2.45	5,786
460..	100	46.8	17.0	14,250	1.4	2,313	552	2,293	83	83	2.52	6,595
367 ..	102	41.0	17.0	10,606	1.8	2,085	75	2,161	381	381	1.86	6,381
434..	104	34.0	14.0	5,630	1.3	1,127	160	854	− 55	− 55	2 25	4,486
449...	105	48.5	16.0	14,248	1.8	2,781	74	2,685	760	760	1.96	8,180
386...	108	35 0	16.5	11,956	1.7	1,939	529	2,506	240	240	2 38	6,122
440...	108	34.0	14 5	8,765	1.3	1,872	480	1,564	797	797	1 76	6,498
372 .	110	44.0	19.0	12,162	1.2	2,455	213	1,605	1,615	1,615	2.27	6,468
381...	110	40.0	13.5	11,930	2.2	2,178	20	2,449	− 925	− 925	3.25	8,265
399...	110	42.5	14 5	9,498	2.5	1,474	269	1,649	200	200	2 31	5,867
429...	110	39 5	23.0	19,710	1.7	3,328	894	2,644	596	596	1 67	7,005
443..	110	35.0	15.5	7,355	2.2	1,921	172	2,071	809	809	1.87	6,655
388...	112	61.0	16.0	9,125	1.8	1,618	106	2,576	67	67	1.93	5,301
446...	112	46 3	24.0	22,342	2.8	3,873	275	4,168	1,242	1,242	1 74	8,640

396...	116	69.0	33.5	21,410	2.6	4,560	217	4,631	438	36	1.95	6,318
441...	120	39.0	15.0	9,111	2.0	1,485	348	1,561	17	17	1.74	5,370
447...	123	41.0	25.5	19,886	2.2	2,685	451	3,786	−1,607	−1,607	2.93	5,505
403...	125	74.5	19.5	13,932	1.7	865	1,563	2,301	− 34	− 34	5.16	2,747
442...	125	34.5	24.0	18,543	2.1	3,491	711	4,461	1,532	1,532	1.26	7,453
451...	125	54.0	17.0	15,504	2.0	1,641	454	2,214	1,872	1,872	3.36	5,377
455...	125	78.5	17.5	15,184	2.5	1,719	88	2,417	− 508	− 508	3.03	5,908
458...	125	101.0	17.0	23,768	2.9	2,169	5,814	5,415	1,496	1,496	2.49	6,049
408...	126	62.0	15.5	17,070	1.7	1,464	84	1,816	−1,003	−1,003	3.05	5,082
427...	128	60.0	25.0	12,872	2.2	2,925	167	2,954	173	173	2.21	6,052
423...	130	65.0	22.0	16,912	2.1	4,804	12	2,963	1,821	1,039	2.05	8,264
432...	133	48.0	20.0	12,708	2.0	2,295	220	2,588	− 278	− 692	2.45	4,840
401...	135	58.5	20.5	19,489	2.0	2,102	146	2,429	− 181	− 181	2.63	5,068
450..	135	51.0	19.5	12,052	2.0	1,081	238	1,866	− 216	− 216	3.52	3,337
435...	137	56.0	22.0	14,839	3.7	2,174	....	3,668	−1,945	−1,945	2.11	5,132
425...	140	62.5	23.0	12,762	2.0	3,534	320	2,526	761	257	1.85	6,671
392...	147	50.0	16.0	8,784	2.2	2,142	1,976	3,462	816	777	2.21	6,412
415...	147	34.5	17.5	8,128	1.3	1,779	105	2,230	313	313	2.51	5,294
365...	150	64.0	15.0	12,410	1.4	2,192	165	1,630	342	342	1.86	7,094
368...	150	56.0	31.5	14,672	2.3	3,358	1,112	5,817	− 421	− 421	2.80	5,215
411...	150	45.0	23.5	12,096	2.2	2,725	225	2,699	− 134	− 134	2.00	6,670
419 ..	153	61.0	20.0	22,459	1.7	2,260	675	2,421	393	393	3.11	6,370
387...	160	55.5	25.5	15,565	2.4	3,429	817	2,398	1,120	1,120	1.62	6,537
402...	160	68.0	26.0	17,268	2.2	3,457	908	2,833	690	690	2.20	7,139
452...	160	59.0	17.0	8,810	1.2	897	143	1,765	− 763	− 763	3.86	2,797
461...	163	69.0	29.0	18,615	1.8	3,056	1,680	4,328	−1,046	−1,046	3.79	5,193
390...	165	58.0	23.5	37,335	2.5	4,752	300	5,950	807	807	1.34	10,447
444...	165	80.0	31.5	17,370	3.2	3,110	416	6,859	− 341	− 384	3.28	5,244
462...	165	103.0	32.0	33,044	2.9	3,945	1,425	5,541	−1,901	−2,597	3.88	4,737
465...	170	53.0	15.5	16,822	2.2	1,837	226	3,483	−1,639	−1,928	2.18	6,180
383...	173	70.5	34.5	20,185	3.2	7,352	610	6,246	1,474	1,474	1.61	10,756
407...	174	96.0	28.0	12,922	2.0	3,934	705	2,501	2,053	2,053	1.64	6,629
389...	176	84.0	25.0	19,410	2.1	2,303	754	2,208	− 341	− 361	2.47	4,694
379...	180	92.0	38.0	18,152	3.5	5,183	1,260	5,839	1,046	1,046	2.08	6,389
405...	180	64.5	19.0	23,140	2.5	2,137	2,346	5,913	681	681	3.67	5,434
366...	182	71.0	35.5	17,827	2.8	4,086	....	5,075	− 364	− 364	1.96	6,025
391...	190	86.0	29.0	17,756	2.5	3,429	512	3,013	535	535	1.74	6,041
412...	190	59.0	20.0	14,798	2.1	2,204	753	2,188	78	78	2.20	5,966
459...	195	76.0	20.0	18,525	2.7	2,829	197	3,362	−1,550	−1,550	3.58	7,518
378...	197	89.5	25.0	18,315	2.0	4,523	443	4,323	424	424	1.78	8,954

TABLE 46 (*concluded*)

Farm no.	Acres operated	Acres of crops	Number of cows	Average total capital	Man equivalent	Milk sales	Crop sales	Current farm expenses	Labor income	Labor income on pool-price basis	Cow cost of milk per 100 pounds	Pounds of milk produced per cow
431...	197	63.0	30.0	$10,564	2.9	$3,132	$ 169	$2,062	$ 775	$ 775	$1 78	5,764
374...	198	62.5	14.5	8,034	3.2	1,699	215	3,586	−1,398	−1,398	2 35	6,391
439 ..	204	40.5	25.5	18,750	2 0	3,135	.....	3,160	− 468	− 468	2.80	6,748
418...	205	55.0	28.0	22,920	2.7	2,172	72	4,208	−3,360	−3,360	3.58	3,873
377...	210	65.0	23.5	14,576	2.5	4,925	219	5,198	741	741	1 79	9,840
404...	210	91.0	28.0	21,370	3.8	3,190	4,650	7,447	− 256	− 256	1.51	5,774
428...	219	64.5	25.0	15,480	3.1	4,380	912	4,270	− 10	− 683	2 20	7,566
453...	221	69.5	30.5	20,065	2.2	3,888	132	3,892	−1,613	−1,613	2.13	6,392
409...	233	97.0	29.5	35,760	3.1	3,751	1,611	6,339	−2,153	−2,153	3 27	7,185
364...	240	53.8	22.5	10,620	1.3	2,508	145	1,864	1,562	1,562	1 48	5,980
437...	240	80.0	24.5	21,568	2.0	2,691	303	2,311	125	125	2.24	5,944
448...	246	138.0	40.5	40,962	4.5	6,161	968	8,848	− 230	− 230	2 36	8,116
398...	257	79 0	23.5	18,088	1.8	2,430	363	2,885	−1,107	−1,107	3.64	5,313
373...	260	68.0	36.5	21,265	2.2	5,529	20	4,009	− 664	− 664	2 58	7,036
413...	300	97.0	46.0	22,852	2.4	4,467	910	4,060	− 778	− 778	1 91	5,161
384 ..	320	133.0	34.5	34,800	3.8	3,961	913	6,289	−1,974	−1,974	2 52	6,415
400...	550	151.0	42.5	44,880	3.8	4,807	167	8,444	1,336	1,336	3 09	6,223

Since the crop prices were low in 1922, the most successful farmers were those who were getting an efficient production from their dairies. The labor incomes, production per cow, and cost of milk, for each farm, arranged according to the cost of producing milk in 1922, are shown in table 47:

TABLE 47. COST OF PRODUCING MILK, PRICES RECEIVED, AND LABOR INCOMES, ON DAIRY FARMS IN 1922

(Arranged according to cost of milk)

Farm no.	Cost of milk per 100 pounds	Labor income	Labor income on pool-price basis	Pounds of milk produced per cow	Average price received for milk (certificates of indebtedness plus cash) per 100 pounds	Crop sales per farm
442......	$1.26	$1,532	$1,532	7,453	$2.10	$ 711
390......	1.34	807	807	10,447	2.13	300
364......	1.48	1,562	1,562	5,980	1.99	145
404......	1.51	− 256	− 256	5,774	2.09	4,650
383......	1.61	1,474	1,474	10,756	2 11	610
387......	1.62	1,120	1,120	6,537	2.13	817
407......	1.64	2,053	2,053	6,629	2 17	705
429......	1.67	596	596	7,005	2 11	894
446......	1.74	1,242	1,242	8,640	2.14	275
441......	1.74	17	17	5,370	1.98	348
391......	1.74	535	535	6,041	1 98	512
440......	1.76	797	797	6,498	2.04	480
376......	1.77	1,239	1,239	9,491	2.28	7
433......	1.78	− 154	− 154	4,196	1.98	350
431......	1.78	775	775	5,764	1.99	169
378......	1.78	424	424	8,954	2.09	443
377......	1.79	741	741	9,840	2.21	219
425......	1.85	761	257	6,671	2.41	320
367......	1.86	381	381	6,381	2.19	75
365......	1.86	342	342	7,094	2 28	165
443......	1.87	809	809	6,655	2 05	172
438......	1.89	481	481	6,838	2.19	1,221
413......	1.91	− 778	− 778	5,161.	1.93	910
371......	1.91	888	888	6,048	2.08	648
388......	1.93	67	67	5,301	2.00	106
396......	1.95	438	36	6,318	2.23	217
449......	1.96	760	760	8,180	2.24	74
366......	1.96	− 364	− 364	6,025	1.95	....
411......	2.00	− 134	− 134	6,670	1.89	225
417......	2.03	1,599	1,216	7,542	2.50	269
423......	2.05	1,821	1,039	8,264	2.67	12
379......	2.08	1,046	1,046	6,389	2.22	1,260
435......	2.11	−1,945	−1,945	5,132	2.07	....
453......	2.13	−1,613	−1,613	6,392	2.06	132
465......	2.18	−1,639	−1,928	6,180	2.48	226
428......	2.20	− 10	− 683	7,566	2.35	912
412......	2.20	78	78	5,966	1.94	753
402......	2.20	690	690	7,139	2.04	908
427......	2.21	173	173	6,052	2.15	167
392......	2.21	816	777	6,412	2.17	1,976
406......	2.22	342	342	6,537	2.12	1,293
437......	2.24	125	125	5,944	2.01	303
434......	2.25	− 55	− 55	4,486	1.94	160
372......	2.27	1,615	1,615	6,468	2.11	213

TABLE 47 (*concluded*)

Farm no.	Cost of milk per 100 pounds	Labor income	Labor income on pool-price basis	Pounds of milk produced per cow	Average price received for milk (certificates of indebtedness plus cash) per 100 pounds	Crop sales per farm
399......	$2.31	$ 200	$ 200	5,867	$1.79	$ 269
374......	2.35	−1,398	−1,398	6,391	2.04	215
448......	2.36	− 230	− 230	8,116	2.11	968
386......	2.38	240	240	6,122	2.11	529
380......	2.38	315	315	6,812	2.23	284
456......	2.45	101	101	5,786	2.00	225
432......	2.45	− 278	− 692	4,840	2.47	220
393......	2.45	892	892	6,709	2.01	638
389......	2.47	− 341	− 361	4,694	1.99	754
458......	2.49	1,496	1,496	6,049	2.14	5,814
415......	2.51	313	313	5,294	2.03	105
460......	2.52	83	83	6,595	2.19	552
384	2.52	−1,974	−1,974	6,415	1.97	913
373......	2.58	− 664	− 664	7,036	2.17	20
362......	2.58	924	924	5,979	2.10	798
395......	2.61	−1,422	−1,422	5,364	2.04	39
401......	2 63	− 181	− 181	5,068	2 09	146
454......	2 72	− 106	− 106	5,697	2.11	....
439......	2 80	− 468	− 468	6,748	1.98	....
368.....	2 80	− 421	− 421	5,215	2.13	1,112
414.. ..	2 92	− 177	− 568	6,504	2.42	....
447.....	2.93	−1,607	−1,607	5,505	2.10	451
397......	3.01	1,268	577	6,091	2.68	1,445
455......	3.03	− 508	− 508	5,908	2.04	88
430......	3.03	−1,395	−1,395	6,004	2.13	90
408.....	3.05	−1,003	−1,003	5,082	2.08	84
410.....	3.09	− 73	− 153	4,759	2.10	60
400......	3.09	1,336	1,336	6,223	2.23	167
419......	3.11	393	393	6,370	1.99	675
381......	3.25	− 925	− 925	8,265	2.11	20
409......	3.27	−2,153	−2,153	7,185	2.00	1,611
444.....	3.28	− 341	− 384	5,244	2.10	416
451......	3.36	1,872	1,872	5,377	2.07	454
394......	3 44	−1,102	−1,102	5,488	1.93	315
450.....	3.52	− 216	− 216	3,337	1.73	238
459......	3.58	−1,550	−1,550	7,518	2.00	197
418......	3.58	−3,360	−3,360	3,873	2.16	72
398......	3.64	−1,107	−1,107	5,313	2.11	363
405......	3.67	681	681	5,434	2.11	2,346
461.....	3.79	−1,046	−1,046	5,193	2.06	1,680
452......	3.86	− 763	− 763	2,797	2.02	143
462......	3.88	−1,901	−2,597	4,737	2.63	1,425
375......	4.40	−1,787	−1,787	4,893	1.99	227
403......	5.16	− 34	− 34	2,747	1.80	1,563

SUCCESSFUL FARMS IN 1922

Farm no. 423, a straight dairy farm of 130 acres with 22 cows, made a labor income of $1821. The milk was not sold thru the Dairymen's League Cooperative Association; the average price was $2.67 per 100 pounds. The crop sales were only $12, from potatoes. The herd production averaged

8264 pounds per cow. Of grain, 2341 pounds per cow was fed. One man was kept for 11 months. If pool prices had been received, this farmer would still have made a labor income of $1039 from his good cows.

Farm no. 417 is a small farm of 63 acres, with 335 hens, crop sales of $269, and 16 cows producing an average of 7542 pounds of milk per cow. The operator and his wife do all of the work. The three-years average labor income on this farm was $1524, and the labor income for 1922 was $1599. This farm is successful primarily because of a high rate of production with no expense for hired help.

Farm no. 372, another small dairy farm of 110 acres, has 44 acres of crops and 19 purebred Holstein cows. The operator and his wife do the work. The labor income was $1615 at pool prices. Crop sales were: potatoes, $40; cabbage, $72; peas, $101; total, $213. The average production of milk was 6468 pounds per cow.

Farm no. 442 was a cash-rented farm of 125 acres. It carried a herd of registered cattle—24 cows and 7 cattle units of young cattle owned by the operator. The crop sales were $711; the operator's labor income, $1807; and the landlord's return on the capital, 2.8 per cent.

Farm no. 364 was an owned farm of 240 acres with 22 cows. The crop sales amounted to $145. The labor income was $1562, with a production of 5080 pounds of milk per cow; but only three months of labor was hired in addition to the operator.

The farms with the highest and those with the lowest crop sales had a higher cost of milk, and made lower labor incomes, than the farms with crop sales of from $500 to $1000 (table 48). Cash crops are important; but when their production gets beyond what the regular help of the farm can grow, the expense of production is likely to be high and the net income correspondingly reduced.

TABLE 48. RELATION OF CROP SALES PER FARM TO LABOR INCOME AND COST OF MILK

Crop sales per farm	Number of farms	Average crop sales per farm	Average labor income per farm	Average cost of milk per 100 pounds
Less than $500	56	$ 187	−$102	$2.47
From $500 to $1000	19	748	+ 430	2.12
More than $1000	13	2,107	+ 25	2.92

SUCCESSFUL FARMS FOR THREE CONSECUTIVE YEARS

Of the farmers included in the Earlville region, 76 have given records for three successive years. Of these 76, only 3 made labor incomes of more than $1000 each year. It is the average that counts most in farming, not the results in a single year.

Farm no. 407 was one of the three that made a labor income of more than $1000 in each of the three years. This farmer combines a herd of 30 fall-freshening, heavy-producing, grade cows, with the production of from 7 to 14 acres of potatoes, cabbage, and market peas on a 174-acre farm with 87 acres of crops. His milk was sold thru the Dairymen's

League Cooperative Association, Inc., during the entire period. The three-years average of milk receipts was $4125, of crop sales $1649, of milk production per cow 7091 pounds, and of labor income $1932. One unmarried man is kept by the year. The operator is a young man, thirty-five years of age, and is a really successful farmer.

Farm no. 442 combines a herd of fall-freshening registered Holsteins with cash-crop production. The three-years average of milk sales was $3764, of crop sales $1786, of milk production per cow 7075 pounds, and of labor income $2061. This farmer also was in the pool of the Dairymen's League Cooperative Association, Inc., during the entire period. The system differs from that of the preceding farm only in that it combines registered cattle, instead of grades, with cash-crop production.

Farm no. 364 is a dairy farm of 240 acres, with only 55 acres of crop land, and with 23 good grade cows. Crop sales averaged $231 for the three years. The three-years average labor income was $1585 at pool prices for milk. From 125 to 250 hens were kept. Very little help was hired, so that expenses were kept down. This farm is successful, largely because of its low expense and its herd of good cows.

The three farms just discussed emphasize the fact that for continuous success in this region it is essential that the farm be not overcapitalized, that it shall have a good two-man dairy of about 30 cows, and that it shall produce enough cash crops to more than pay the hired help.

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The Spruce Gall-Aphid

Glenn W. Herrick and T. Tanaka

A GROUP OF GALLS ON SPRUCE IN JULY

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THE SPRUCE GALL-APHID

(*Adelges abietis* Kaltenbach)

Order, *Homoptera* Family, *Phylloxeridae*

Glenn W. Herrick and T. Tanaka

Certain of the native spruce trees in this country, and one introduced species, the Norway spruce, are infested with a species of aphid, *Adelges abietis,* which causes galls of a familiar pine-apple type on the branches. The Norway spruce is especially subject to the attacks of this pest. All of the spruces, because of their evergreen character and their dense and shapely growth, are attractive trees in the plantings of both small and large grounds, and are useful for windbreaks in various situations. The Norway spruce is often used for hedges, but various factors contribute to its undesirability as a hedge plant, notably the injuries produced by the gall-aphid.

HISTORY, DISTRIBUTION, AND INJURY

It is not possible to give a detailed history of the spruce gall-aphid in America because the insect has been confused in the literature with other closely related species and one cannot be sure of the species under discussion. It was certainly introduced from Europe probably many years ago. It is widely distributed in the northeastern United States and in southern Canada. Just how far west it extends, we have no accurate means of knowing. It has a wide distribution in New York, for the typical galls have been received from many different localities. It appears to be more common and injurious in New York, Pennsylvania, and the New England States, than in any other part of the United States.

In this country the insect attacks particularly the Norway spruce (*Picea Abies*) and the white spruce (*Picea canadensis*). Britton (1924) records it as attacking also the black spruce (*Picea mariana*), the red spruce (*Picea rubra*), and sometimes the hemlock (*Tsuga canadensis*). The Colorado blue spruce (*Picea pungens*) is infested with a closely related species of gall-aphid (*Chermes cooleyi* Gillette), which causes galls on the branches similar in appearance to those of the spruce gall-aphid but longer and nearly always at the ends of branches, as shown by Gillette (1907–08).

The spruce gall-aphid is seriously injurious to Norway spruces especially, and is particularly harmful to young trees. There may be hundreds of the galls on a single small tree. Miss Patch (1909) counted 990 fresh galls on a white spruce three feet tall. The writers have seen as many on Norway spruce. In cases of such severe infestation, many of the branches are usually killed and often single young trees in hedges are killed outright, although the crowding and pruning undoubtedly contribute to the unhealthy condition of the plants. When branches are severely infested with the galls, they begin to shed their leaves and the tree becomes

d and unsightly in appearance. The work of the insect is a distinct cap to the nurseryman, because customers do not like to purchase already infested with the unsightly galls, and they really should not t infested trees unless they feel inclined to take vigorous measures of ol after the trees have been set. The effect of the galls is to cause to become deformed and misshapen, thus detracting from their beauty ttractiveness.

SCIENTIFIC AND COMMON NAMES

his aphid, together with other closely related species, has been placed ofore in the genus Chermes, and this particular species has been vn as *Chermes abietis*. It is found under this name in the references herein, in all except one instance. Comstock (1924) says it has determined that the name *Chermes* should be applied to certain jump-plant-lice of the family Chermidae formerly known as the Psyllidae, that those insects found on conifers which have been "quite generally wn" under the generic name *Chermes* should be placed in the sub-ily Adelginae. Therefore the forms on conifers heretofore known as *rmes* will fall in the genus Adelges, and the species under discussion be known as *Adelges abietis*.

he insect has been given several common names—*spruce gall-louse*, *ropean spruce bud-louse*, *yellow chermes*, *green-winged chermes*, and *en-winged adelges*. It seems to the authors that the common name *uce gall-aphid* comes nearer to expressing the common and distinctive racteristics of the insect than any of the other names mentioned. The ect is an aphid, and its peculiar, distinctive, and commonly known ury to its food plant is in the form of a gall. The name *spruce gall-nid*, therefore, indicates at once its food plant, its character and position ong insects, and the form of its injury.

DESCRIPTION OF FORMS

The wingless oviparous female

The body of the adult wingless oviparous female is grayish green and covered with a white waxy pulverulence which increases with age. The oups of pores are dark, and the mouth parts, antennae, and legs are rk brown. The body is more or less globular and oval as viewed from e dorsum. It is from 1.5 to 2 millimeters long and from 1 to 1.5 mil-neters wide.

The head and the thorax are closely joined, and there are three trans-erse rows of groups of dorsal pores in this region. The mesothorax, e metathorax, and each segment of the abdomen, bear a transverse dorsal ow of groups of wax pores. The groups of pores are arranged on the ody in six longitudinal rows, four rows along the dorsum proper and ne additional row along each side of the body. Near the caudal end of he body the two side rows disappear. The number of wax pores in ach group is large, but is not the same in all of the groups. The wax ores are not so numerous on the ventral side of the body, although there re from two to four groups on most of the segments. There are two

pairs of spiracles on the ventral side of the thorax, and at least four pai on the abdomen.

The antennae are short but conspicuous. The first segment is sho and thick, the second is slightly longer but somewhat slenderer, while tl third and last is as long as or longer than the first two. The stylets (the mouth parts are very long. The legs are short and are wholly co cealed beneath the body. The tarsi are two-segmented, with the fir segment very short.

The eggs of the wingless hibernating female

The eggs of the wingless hibernating female are laid in clusters of fro 150 to 200, or even more, beneath the body of the female. They a oblong elliptical in shape, and greenish yellow in color when first lai Later they turn darker, but they become yellowish again just before hatc ing. Each egg is furnished with a slender white waxy thread at least twi as long as the egg itself. This thread seems to be entangled among an connected with other longer threads underlying the batch of eggs an holding the mass fast to the branches.

The actual measurements of different eggs are as follows:

0.30 × 0.15 mm.	0.32 × 0.165 mm.
0.30 × 0.155 mm.	0.34 × 0.165 mm.
0.30 × 0.16 mm.	0.34 × 0.170 mm.

The first-instar nymph

The newly hatched nymph is yellow in color and the appendages a more or less transparent. The eyes are dark and each one seems to po sess three facets. The antennae are three-segmented, the first two se ments being short and the third one being longer than both of the together. There are no wax pores on the body.

Different individuals measure as follows:

0.42 × 0.20 mm.	0.47 × 0.22 mm.
0.42 × 0.22 mm.	0.49 × 0.23 mm.
0.45 × 0.21 mm.	

The second-instar nymph

The general color of the body and appendages in the second-inst nymph is very similar to that of the first-instar nymph, except that tl body is now covered with a fine whitish waxy powder. The wax por are therefore present, but they are not highly developed except on the he and the prothorax, where they are conspicuous.

The measurements of individuals are as follows:

0.27 × 0.51 mm.	0.32 × 0.64 mm.
0.28 × 0.56 mm.	0.34 × 0.64 mm.
0.29 × 0.61 mm.	0.36 × 0.67 mm.

The third-instar nymph

The body of the third-instar nymph is yellowish green and is cover with a white powdery secretion of wax. The appendages and the mou

parts are light brown. The wax pores are well developed on the anterior part of the body. The nymph usually carries a cast skin, and sometimes two of them, attached to the posterior end of the body. These skins are filled with liquid and are more or less globular in shape.

Individuals of this stage measure as follows:

0.37 × 0.80 mm.	0.48 × 0.96 mm.
0.40 × 0.80 mm.	0.50 × 0.99 mm.
0.40 × 0.82 mm.	0.53 × 0.99 mm.
0.40 × 0.88 mm.	0.58 × 1.09 mm.
0.44 × 0.88 mm.	

The fourth-instar nymph, or pupa

In the nymph of the fourth instar, the body is stout and the wing-pads are well developed. The nymph is yellow in color and noticeably pulverulent. The eyes are black and prominent, and the legs are dark. This stage, which is of long duration, enables the nymph to grow considerably, and the individuals vary greatly in size. The following measurements show the variation in size:

0.68 × 1.32 mm.	0.90 × 1.99 mm.
0.78 × 1.61 mm.	0.90 × 2.02 mm.
0.80 × 1.75 mm.	0.94 × 2.10 mm.
0.85 × 1.90 mm.	1.03 × 2.21 mm.

The antennae are similar to those of the preceding instar, and the prothorax is fairly well differentiated from the fused meso-metathorax. The wing-pads of the mesothorax are large and extend to the middle of the second abdominal segment, while the hind wing-pads are smaller and are usually concealed beneath the front ones. The situation of the wax pores are well described by Miss Patch (1909) as follows:

> Head with an anterior group of pores near base of each antenna and two median groups at posterior margin; prothorax with lateral gland area, an anterior median pair of groups, a small group (4 pores) between the lateral and median ones, and four groups near posterior margin of prothorax; mesothorax with an anterior lateral area; metathorax with two separated median groups; abdomen with small and widely separated median groups on segments I-VI, those on I being composed of about 6 pores, those on II of 3 and those of III-VI of 2 each, a very small group of lateral pores occur on segments II-IX (merged to a caudal group on IX), and about half way between the median group and lateral margin an additional group of about 3 pores occurs on segments I and II. The smallness of these inconspicuous groups is correlated aptly with the fact that this is not a flocculent species, the wax secretions not exceeding the pulverulent condition.

The winged oviparous female

In the winged oviparous female, the wings have an expanse of from 5.4 to 6.3 millimeters. The head is dark brown and about three times as wide as its length. The compound eyes are prominent and black. The antennae are smoky yellow and five-segmented; the first segment is short and stout, the second is longer than the first but less in diameter, the third is longer than the second, and the fourth and the fifth are sub-equal in length but are longer than the third (figure 1). Miss Patch (1909) says:

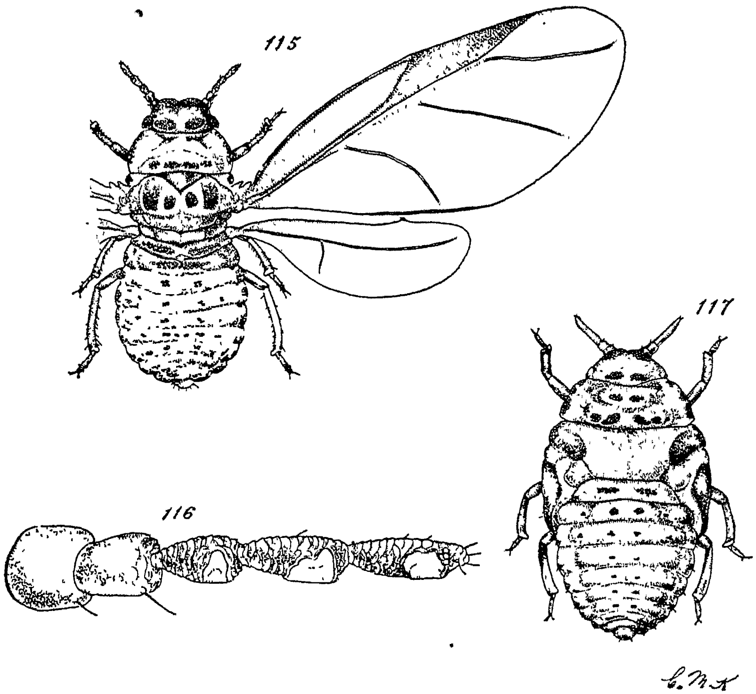

FIGURE 1. THE SPRUCE GALL-APHID

115, The winged female, which emerges from the gall in August. 116, Antenna of the winged female. 117, The pupa, which develops in the gall

(From Bulletin 173, Maine Agricultural Experiment Station)

"The sensorium of each of antennal joints III-V is confined to the distal half of the joint and extends not more than half way around the joint." There is a group of smaller sensoria on V.

The prothorax is smoky greenish yellow, with a dark triangular area in the middle of the dorsum; the mesothorax is pale yellow, with a dark triangular area near the front margin in the middle. Near the caudal border of the metathorax is a subquadrangular dark transverse plate. In the normal position the wings are folded along the abdomen in a roof-like manner. The fore wing has a wide green costal margin and a green stigma. The legs are slender and yellowish. The tarsi are two-segmented, with the basal segment very short and small and often concealed beneath the tip of the tibia. The abdomen is smoky yellow, with segments fairly distinct. The groups of wax pores "are much as in the pupa except for the abdomen which is as follows: I with median groups comparatively large and merged, II median groups separated and composed of 2 pores each, V with two small groups between median ones referred to. I-VIII with distinct lateral groups on darkened area, III-VI with small groups of 2 or 3 pores each midway between median and lateral groups" (Patch, 1909).

The measurements vary as follows:

Length of body	Expanse of wings
1.58 mm.	5.4 mm.
1.73 mm.	5.7 mm.
1.88 mm.	5.8 mm.
1.91 mm.	6.0 mm.
1.92 mm.	6.2 mm.
1.98 mm.	....
2.07 mm.	6.3 mm.
2.10 mm.	....

The eggs of the winged oviparous female

The eggs of the winged oviparous female are laid beneath the body of the female, while she sits lengthwise of a leaf, in a cluster of from 40 to 50. They remain covered with the dead body of the female, together with what waxy threads she may have secreted. They are dull yellow at first, and later become darker. Each egg is furnished with a waxy thread at one end.

The eggs measure as follows:

0.18×0.34 mm.	0.20×0.36 mm.
0.18×0.36 mm.	0.20×0.38 mm.
0.18×0.38 mm.	0.22×0.34 mm.

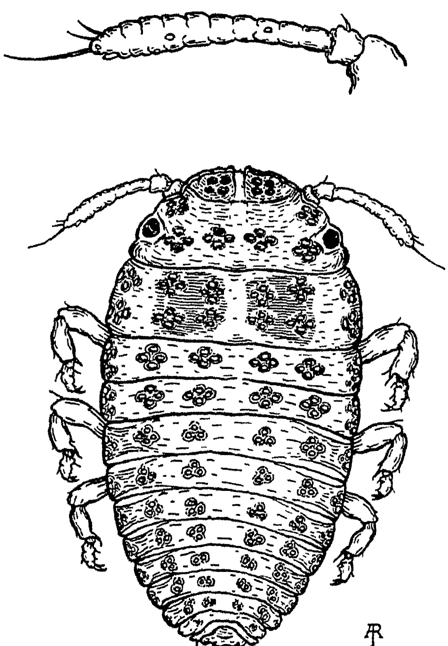

FIGURE 2. FIRST-INSTAR NYMPH OF THE OVERWINTERING FEMALE, THE FORM WHICH PASSES THE WINTER ON THE SPRUCE

The first-instar nymph of the hibernating oviparous female

In the first-instar nymph of the hibernating oviparous female, the body is slender and the appendages are rather long. The body is light yellow when first hatched, but later becomes darker and somewhat green. The antennae are long and are composed of three segments, the first and second of which are short while the third is comparatively very long. The groups of wax pores are conspicuous and abundant. In general, they form six longitudinal rows as seen from above, four rows situated medianly and one row on each lateral edge of the body. There are usually four pores in each group of the median rows on the head, the thorax, and the first segments of the abdomen, but on the posterior segments of the abdomen there are more often but three pores in a group. Each of the lateral

groups tends to have numerous pores. This form (figure 2), which passes the winter on the branches of the spruce at the bases of buds, secretes more or less wax in the form of white threads that usually cover the body.

LIFE HISTORY

The spruce gall-aphids pass the winter as first-stage female nymphs clustered in crevices of the stem about the bases of the buds. On severely infested spruces the overwintering forms are abundant, there being as many as twenty to thirty about one bud. When examined with a lens they are seen to be purplish gray, but to the unaided eye they resemble small grains of gunpowder. By May 5, in 1923, the spruce buds had begun to grow and many of the nymphs had molted. So far as the writers' observations have gone, but one molt has been found in this generation, but some molts may have been missed. The females increase in size, and begin to secrete long, crinkly, curly, white, waxy hairs, and become bluish green in color. They all settle now at the bases of the developing branch buds. The weather continued cold after the above-named date, and the females remained rather stationary in development for a week. By May 16, however, females were found which had just begun to lay eggs. The individuals develop fairly in unison, although there are belated ones here and there that are sometimes a week behind the earlier ones in depositing eggs. By the end of May, in 1923, nearly if not quite all were depositing eggs. There is some evidence to indicate that egg laying is influenced by the development and activity of the tree. The buds on some trees start much earlier than do those on others, and on those trees which start early the aphids are found to be depositing eggs, while on the spruces, which are then still dormant, the aphids are inactive. At least this proved to be the case in some instances which the writers were fortunate enough to observe.

Each female deposits from 150 to 200 or more eggs beneath her body. On May 18 a female under observation was observed to exude from the caudal end of the abdomen a drop of liquid which appeared to be evidence of a beginning of activity in egg laying. On the 19th she became covered with a secretion of waxy threads. On the 21st, eggs could be seen beneath the body. These increased in number until, by the 29th, 198 eggs had been laid, some of which had already hatched. It is difficult to determine the exact length of the egg-laying period, because the first

FIGURE 3. OVERWINTERING FEMALES BEGINNING TO LAY EGGS, MAY 22

The insects are covered with white waxy threads

eggs are completely hidden by the body of the female and it is not easy to determine when fresh eggs have been added to the mass already present. The period appears to range from eight to fifteen days. For the reasons just given, it is difficult to determine the total number of eggs laid by a single female, but the number certainly ranges from 150 to more than 200, and probably as high as 250. The eggs and the body of the female are covered by a white mass of waxy threads and are more or less completely hidden from view (figure 3).

The eggs hatch in about one week. A female was removed from a batch of eggs on May 23. The eggs had been deposited on the 21st and 22d. On the 25th the light yellow eggs had turned green, and on the 26th the eyes of the embryo could be seen in some. On the 28th two eggs hatched, and on the 30th nearly all had hatched. The period of hatching, in this case, varied from seven to ten days, which is probably about the average period.

Formation of the galls and development of the nymphs

In 1923 the earliest nymph observed emerged from the egg on May 19. Others kept emerging up to June 5, by which time, in normal years, nearly if not quite all of the eggs will have hatched. The nymphs are active and they very soon crawl down behind the leaves of the buds, which have already begun to enlarge at their bases.

Formation of the galls

Cooley (1897) says:

> A very young shoot broken out from the bud scales before any of the eggs have hatched shows the basal leaves on the side where the female passed the winter, distinctly swollen at the base. The starting of the gall must therefore be attributed to the female rather than to the nymphs. It is reasonable to suppose, however, that the nymphs settling in the partially formed gall have some influence on its further development.

All of our observations lead us to agree with this statement. In the case of a developing bud, at the base of which one or more females are situated with their beaks inserted in the tissues, we find more or less of the outer leaves of the bud enlarged and deformed even before the eggs hatch. The bases of these affected leaves are wider and thicker than the normal leaves. As the nymphs appear and crawl in between the bases of the leaves and insert their beaks into the tissues of the leaves, the irritation and stimulation are maintained and increased and the basal part of the affected leaves enlarges rapidly until a characteristic gall is formed. A normal bud, when it starts in the spring, is larger in diameter at the tip than at the base. On the contrary, a bud at the base of which one or more female aphids are hibernating, is as large in diameter at the base, and more often larger, than at the tip, when it begins to grow. The aphid unquestionably imparts to the leaves of the bud a stimulation that begins the formation of the gall.

The newly hatched nymphs are fairly active, and crawl up the young shoot which is now growing rapidly. They soon seek the spaces behind the modified leaves and crawl down among the bases of them. The modification of the leaves is apparently accelerated by the influence of the nymphs, for each leaf covering the aphids enlarges at the basal part while the distal part remains of normal size. Since the basal parts of many leaves become enlarged, a bulbous or gall-like enlargement of the whole

growing branch is formed and the branch itself is checked in growth. If the aphids are abundant enough to occupy spaces between all of the leaves, then the gall is formed the whole way around the branch (see cover illustration). If the aphids are few, the enlargement may take place on one side only of the growing branch. In such an event the branch is usually bent in the direction of the side on which the half-gall is formed. In some cases the gall so completely involves the whole bud that the growth of the branch is entirely checked. In most cases, however, the branch grows more or less beyond the gall, although never probably to what its full normal length would have been if no gall had been formed. Since the galls are deformations of the branch buds, they are always at the bases of branches.

The gall is more or less elongated, about 1 inch long, and shaped much like a pineapple, the sharp distal ends of the leaves answering to the spines and thus increasing the resemblance. The name *pineapple gall* is a very appropriate one. The gall is of a beautiful green color, somewhat yellowish at first but becoming deeper green later. After it has completely formed, reddish pubescent lines appear along the lines of junction of the leaves, and these add to its attractive coloration. The cells of the gall may be from 40 to 50 or even more in number, and each cell, containing from eight to twelve nymphs, is entirely closed. The red lines disappear as the gall grows older, and before the gall opens it turns yellowish in color as though it were ripening. During the latter half of August the leaves begin to separate and openings are formed leading to the cavities in which the aphids are situated. Through these openings the fourth-stage nymphs emerge, and the galls quickly turn dark and dry and harden; but they remain on the branches indefinitely, giving the trees an untidy appearance.

Development of the nymphs in the galls

Several nymphs are ensconced in the cavity behind each leaf, and their development can be traced by opening the galls at varying intervals during their growth. In 1923 the first nymphs to molt were found on June 4, and by June 7 many nymphs in their second instar were noted. On June 18 the first third-instar nymphs were observed, but most of the nymphs were still in the second instar. By July 2 most of the nymphs had transformed to the third instar, and on July 13 the first fourth-instar nymph was found. The fourth-instar nymphs are the so-called *pupae,* for in this stage the wing-pads are developed and are conspicuous. By August 9 most of the aphids had progressed to the fourth instar, and on August 15 the first winged adults were observed. By August 26 to 29, many of the pupae had emerged from the galls and had transformed to winged adults. It was not, however, until from September 5 to 10 that the majority of the galls were open.

The first eggs of the winged females were found on August 22. They were laid beneath the body of the female, on the leaf, to the number of 40 to 50. Many females were depositing eggs by September 11, and the first nymphs to hatch were discovered on that date. Many nymphs were present by September 29.

Emergence and habits of the winged female

When the different cells in the gall open in August, the pupae (fourth-instar nymphs) crawl out of the openings and settle on the leaves. In from

two to three days the nymphs molt and transform to the winged adult oviparous females. These females are certainly very inactive, and in the great majority of cases do not move far from the places in which the respective nymphs have cast their skins. The writers have never seen any indications of a migratory movement among these females. One wonders how this insect spreads from one plant to another, for it certainly does do so although the dispersal from a common center is gradual and very slow. The females settle rather quickly after the body has hardened, and, for the most part, go to the undersides of the branches. In from two to five days each one begins laying its quota of eggs, and the egg-laying continues for about ten days, when the full number, from 40 to 50, have been laid. The female dies when her eggs are all deposited, but her dead body covers the eggs and clings to the leaves long after the young nymphs have settled for the winter. Indeed, the shriveled bodies of the females may be found late in the winter. The eggs, which begin to be deposited during the first week of September, hatch through a period of two weeks, so that some of them do not hatch until the latter part of the month and probably some not until into October.

The young nymphs are active, and crawl about over the leaves apparently inserting their beaks now and then to feed. By the latter part of October most of the nymphs have migrated from the leaves to the twigs and have settled for the winter. They insert their beaks into the tender bark of the twigs, and many of them secrete waxy threads over their bodies. The nymphs tend to gather in groups mostly near the distal ends of the twigs, where they may be found during the winter.

FIGURE 4. AN OVERWINTERING FEMALE JUST BEGINNING TO LAY EGGS, MAY 22

The insect is covered with white waxy threads

Summary of life history

The insects overwinter as small nymphs of the oviparous, wingless, agamic females ensconced in crevices about the bases of the buds. In the spring these nymphs rapidly mature, and in May each adult lays from 150 to 200 or more greenish yellow eggs in clusters beneath her body (figure 4). These eggs hatch in about one week, and the young nymphs crawl down behind the already enlarged bases of the leaves of the spruce buds. The presence of the nymphs causes the leaves to enlarge further and the branch to become checked in its growth, thus forming a large gall resembling a miniature pine-

apple. The nymphs soon become entirely inclosed in the gall, and remain so until August. In the latter half of August (in New York) the galls open, and the nymphs crawl out of their cells, molt, and transform to winged, agamic, oviparous females. These females remain on the spruce, and in August and September each lays a cluster of from 40 to 50 eggs on the leaves. The eggs hatch in about one week, and the nymphs soon settle down in crevices about the buds, there to pass the winter. Thus the life cycle is completed, there being two parthenogenetic generations on the spruce each year.

PARTHENOGENETIC DEVELOPMENT

The species of the genus Chermes have been investigated with great detail in Europe through a period of many years, and considerable controversy has arisen regarding the life history and biology of the species *Adelges (Chermes) abietis*. Blochmann (1890) published a paper in which he held that *Chermes abietis* had an alternate or intermediate host plant, the larch tree. This immediately aroused the curiosity of Cholodkovsky as to how the insect lived in northern Europe, where the larch is not present. As a result of Cholodkovsky's careful and extended study (1910, 1911, 1915), he believed that there were two species of Chermes: one which he called *Chermes abietis* Kalt., and which passed through a cycle of two generations and lived permanently and parthenogenetically on the spruce; and another which he called *Chermes viridis* Ratz., with a cycle of five generations (one sexual) and living on both the spruce and the larch, the latter tree being the intermediate host. The accompanying diagram (figure 5) shows graphically the life cycle of these two species in Europe according to Cholodkovsky. Börner (1908, a and b), adopting the "parallel-row theory" of Dreyfus (1890), maintains that *Chermes abietis* develops two

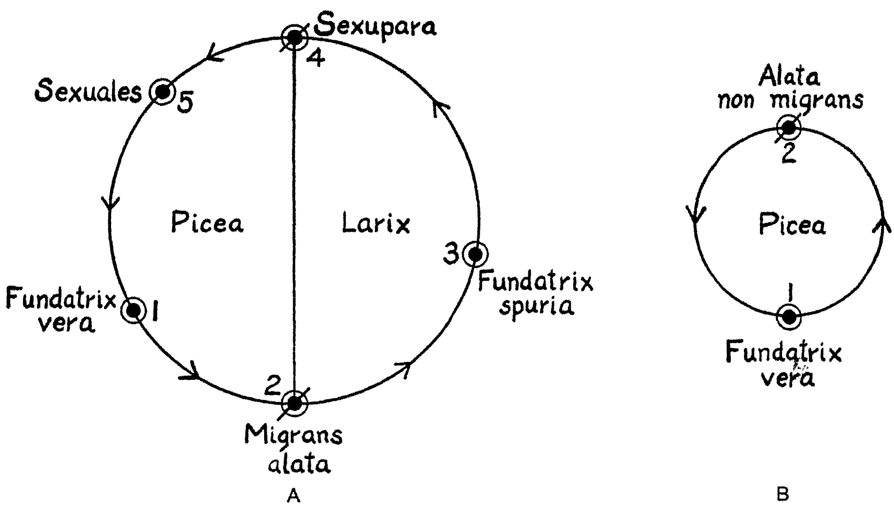

FIGURE 5. GRAPHICAL REPRESENTATION OF THE LIFE HISTORY OF CHERMES VIRIDIS (A) AND OF CHERMES ABIETIS (B), ACCORDING TO CHOLODKOVSKY (AFTER STEVEN)

races or strains or branches as it were, one of which lives on the spruce while the other migrates to the larch and passes through a complex cycle on that plant. In other words, he claims that the sexes (Sexuales) give rise to the hibernating nymphs (Fundatrix) which mature in the spring and lay the eggs that produce the gall-making forms (Fundatrigenia), part of which, when they mature, remain on the spruce and part of which migrate to the larch, thus living in parallel rows, as it were, on the spruce and the larch at the same time. Börner therefore holds that there is but one species of this form *Chermes abietis*, and that the parthenogenetic form of Cholodkovsky does not exist as a distinct species.

Our investigations in the vicinity of Ithaca do not show any sexual forms of this aphid. We have not found any evidence that there is a specific or varietal form or race that lives on the larch, there developing a sexual cycle. We should not like to say that further careful investigation might not disclose such a form. It is a problem that we hope to investigate at greater length. It is of interest in this connection to note that Miss Patch (1909) finds no evidence of *Adelges abietis* going to the larch. She says: "A different species of host plant is never sought by this *Chermes*."

Steven (1918) finds that in Scotland there are two separate cycles of the Chermes under consideration. One is a cycle of two parthenogenetic generations on the spruce, as we have found in Ithaca. This Steven calls *Chermes abietis* Kalt. of Cholodkovsky. He finds also a Chermes with a cycle of five generations, which passes one phase of its life history on the spruce and one phase on the larch. This, he believes, corresponds to *Chermes viridis* Ratz. of Cholodkovsky. This species or race we have not as yet found at Ithaca.

CONTROL

The senior author has been spraying Norway spruces for some years with different materials in an endeavor to control the spruce gall-aphid. Most of these trials have been isolated attempts to control the insect on two or three trees, but in the spring of 1924 an opportunity was offered to make a test on a larger scale. The results (Herrick, 1925) corroborated those of the earlier isolated sprayings and were very satisfactory.

A hedge of Norway spruce trees about five feet high, which runs along one end and about half the length of one side of the grounds of Prudence Risley Hall at Cornell University, has been abundantly infested with the gall-aphid, and the infestation has been gradually increasing until some of the young trees have nearly succumbed to the injuries inflicted by the insect. This hedge, which has a total length of about 550 feet, offered a fine opportunity for trying some control measures.

On April 9, 1924, the hedge was thoroughly sprayed with powdered lime-sulfur at the rate of 16½ pounds to 50 gallons of water. The trees were sprayed from both sides, and care was taken to coat the branches thoroughly with the liquid. The senior author had this hedge under observation throughout the season, and was not able to find a single developing fresh gall. The caretaker of the grounds, who is interested in the problem and aided in the spraying, pruned the hedge in July, and, while doing so, kept a sharp lookout for galls. He failed to find a single one,

and, since he pruned each tree in a rather careful manner, it is likely that he would have seen galls if any had been present.

The senior author has along the front border of his own grounds a hedge of Norway spruce the trees of which are about five feet high. These small trees also have been severely infected with the gall-aphid. On April 21, 1924, this hedge, which is about 75 feet long, was sprayed with Sunoco oil at the rate of 1 part to 20 parts of water. Warm water was used and the oil emulsified readily, forming a very satisfactory milky emulsion. The hedge was sprayed from both sides in a very thorough manner with an abundance of the liquid. During the summer, frequent examinations were made of the trees in search of developing galls. The writer was unable to find any signs of the presence of the aphids and no fresh galls were discovered. It should be remarked that rain began to fall at about three o'clock in the afternoon of the day on which the trees were sprayed, and a drizzle continued through most of the afternoon.

On an individual tree of larger size, sprayed on April 5 with Sunoco oil at the rate of 1 gallon to 15 gallons of water, five freshly developing galls were found, one on June 10 at the tip end of a side branch, and four at the topmost end of the leader. Unquestionably the tip ends of these branches were left untouched by the oil. The lower branches of this tree were covered with old galls and the hibernating nymphs were abundant on nearly all of the branches at the time of spraying. No new galls, other than those mentioned, appeared on the tree.

All of the trees sprayed with oil were watched during the summer and fall for possible signs of injury, but no evidence of the slightest ill effect was observed until early in the following March, nearly a year after the application. Then it was noted that the snow underneath the trees was covered with spruce leaves, and on examination it was found that there appeared to be an abnormal shedding of the foliage. The ends of the branches of nearly all the young trees in the hedgerow were bare of leaves, making the effect very noticeable. The defoliation did not seem to be progressive, and did not appear to be serious although it did give the hedge a somewhat unthrifty and untidy appearance. Indeed, one cannot be positive that the effect was due to the oil, although there was no evidence of abnormal shedding of foliage on unsprayed spruce trees, many of which were examined. Later, on July 25, 1925, the trees were in excellent condition and the hedge showed no injury. On November 10, 1925, the hedge was in a perfectly normal condition.

In the spring of 1925 the attention of the writer was called to two Norway spruces about twenty feet high that were literally covered with the galls of this aphid. The trees had made little growth during the preceding year, and looked ragged and unhealthy. They were two among a half dozen fine trees standing in a row and close together. All of the trees had been making excellent growth, but these two, standing at the end of the row, had become infested, probably from two other infested trees some distance beyond them.

On April 6 these trees were sprayed with Scalecide, 1 quart to 20 quarts of water. The oil was fresh and emulsified very satisfactorily. The trees were sprayed very thoroughly and every part of them was covered. The weather during the next few days was propitious, and the oil had a

chance to do its work. April 7, 8, 9, and 10 were fine days without rain but with rather heavy frosts during the nights.

The results of this spraying with Scalecide seemed, up to November 10, to have been very satisfactory. Observations of the trees during the summer and fall failed to disclose a single new gall. All of the evidence indicated that this miscible oil is nearly a specific in destroying the spruce gall-aphid. There was no evidence of any injury to the tree by the oil, when applied during the spring of the year at the dilution of 1 part to 20 parts of water.

Britton (1924) says, regarding the control of this gall-aphid, that spruce trees have been effectively sprayed for several years with miscible oil, at a dilution of 1 to 20, in the fall and in April, and that there has never been any injury to the trees except once, and that was probably due to the contents of the original package not having been thoroughly mixed before dilution with water. It seems apparent that oil emulsions, miscible oils, and lime-sulfur either dry or liquid, are effective materials for the control of the spruce gall-aphid. The senior author has obtained effective results on a few trees at different times with the concentrated solution of lime-sulfur at winter strength, 1 gallon to 8 gallons of water, when the solution tested 32° Baumé. The lime-sulfur may be somewhat objectionable because it tends to stain the foliage of spruce trees; at least, it gives the trees a whitewashed appearance which may persist for some time and to which some owners might object. The oils do not produce any discoloration of the foliage, and if they do not produce marked injury to the trees, such as may prohibit their use on spruces, they are probably preferable.

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Bulletin 455 October, 1926

Economic Studies of Dairy Farming in New York. VII

Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1923

E. G. Misner

In cooperation with the Bureau of Agricultural Economics of the United States Department of Agriculture

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CONTENTS

ECONOMIC STUDIES OF DAIRY FARMING IN NEW YORK. VII. GRADE B MILK WITH CASH CROPS AND MIXED HAY ROUGHAGE, CROP YEAR 1923

E. G. MISNER[1]

The study of the organization and the cost of milk production on a group of dairy farms in the vicinity of Earlville, Chenango County, New York, producing Grade B milk and growing some cash crops and having mixed hay for roughage, has been conducted for three consecutive years. The results for the third year, ending April 30, 1924, are reported in this bulletin.[2]

REGIONAL CONDITIONS

A general description of the region in which these farms are located has been given in the preceding bulletins of this series.

The climate at Norwich, Chenango County, which is in the southern extremity of the area, in the year 1923 was as shown in table 1.

When the yearly average for the five years from 1910 to 1914 is taken as 100, the index number of wholesale prices in the United States for the twelve months covered by this study averaged 155, milk prices paid to producers at Utica, New York, averaged 146, and the weighted average of prices paid to New York producers for farm products was 141.[3]

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[1] The field work was done by H. P. Bruner, of the Division of Farm Management, Bureau of Agricultural Economics, United States Department of Agriculture, and J. S. Hathcock, of Cornell University. The information was gathered thru a cooperative agreement between the Department of Agricultural Economics and Farm Management of the New York State College of Agriculture at Cornell University, Ithaca, New York, and the Divisions of Farm Management and Cost of Production, Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C.

The following farmers cooperated in furnishing information for the crop year of 1923:

Operators: L. A. Abbott, Frank Adams, L. W. Armstrong, George W. Baker, W. J. Barber, M. H. Bartlett, Fred A. Beecher, Wayne G. Benedict, E. N. Bensley, Arnold P. Berry, W. L. Bierce, E. M. Billings, T. W. Billings, Ezra Briman, Leon H. Brown, J. H. Burke, Herman Button, Burt Butts, F. H. Chrisman, E. B. Clark, W. G. Clark, Close and Hall, W. H. Coleman, L. J. Conley, H. R. Cook, C. J. Coy, I. Davidson, Lewis H. Dennis, H. L. Dewey, F. H. Eddy, William E. Fairchild, D. N. Felt, S. A. Fisher, W. A. Follett, C. L. Frink, H. L. Gager, J. E. Gaines, P. J. Gilmartin, E. Gorton, L. D. Greene, H. D. Groves, F. F. Guthrie, C. H. Hartwell, Clark Holmes, Eugene Howard and son, John Howard, Charles Izard. C. H. Jantzen, W. P. Jeffrey, Charles Jenks, E. H. Jenne, Earl Jones, L. W. Knapp, R. P. Kutschbach and son, John W. Lamb, Homer N. Lathrop, P. J. Lawrence, George H. Leete, C. C. Merrill, R. F. Moore, E. J. Mundy, J. M. Olson, L. W. Paddleford, Hervey J. Pike, Will Pike, W. C. Record, Leslie Reese, E. B. Reynolds, F. Rhoades, W. N. Ross, A. C. Sabin, I. U. Scott, H. N. Sexton, W. H. Shapley, Howard Sisson, L. J. Slentz, Edwin P. Smith, F. J. Snell, E. J. Snitchler, A Squires, Frank A. Starrett, A. P. Svenson, Olin and K. C. Thornton, R. R. Usher, Frank A. Van Housen, B. J. Van Wagner, R. H. Volmer. Floyd Wells, G. D. Whitford, C. G. Wilcox, H. H. Wilcox, M. L. Wilcox, G. W. Wood, S. S. Woodman, Thomas E. Wratten.

Landlords: A. A. Abbott, H. S. Baker, Mrs. B. Bowers, Mrs. Esther Bresee, W. C. Crouch, Mrs. A. Davis, Mrs. B. R. Greene, A. A. Hartshorn, W .H. Hartwell, Clark Holmes, O. S. Langworthy, Henry Lathrop, W. J. Morse, W. F. Plumb, Alfred Reese, D. E. Reynolds, N. F. S. Russell, L. J. Silvernail, F. Skinner, Mrs. Louise Tanner, A. M. Tefft, William L. Titus, W. D. Usher.

[2] The results on the same farms for the two preceding years are given in Bulletins 441 and 452 of this station.

[3] Farm Economics (Cornell University).

TABLE 1. PRECIPITATION AND TEMPERATURE AT NORWICH, CHENANGO COUNTY, IN 1923

	Precipitation		Temperature	
	Inches	Per cent of normal	Actual (degrees F.)	Per cent of normal
1923:				
May	3.24	91	53.3°	96
June	3.70	104	65.6°	103
July	3.77	92	67.5°	98
August	1.94	52	65.4°	98
September	3.80	93	60.8°	100
October	2.81	82	48.1°	97
November	1.98	71	38.6°	105
December	4.03	138	35.4°	143
1924:				
January	2.80	92	25.6°	114
February	3.00	93	19.6°	93
March	0.74	23	31.4°	90
April	4.46	142	44.7°	94
Total or average	36.27	89	46.1°	101

LABOR

The average value placed by the farm operator on his time for twelve months was $81.46 per month. This was about $3 per month lower than for the preceding year. The variations in the estimates are given in table 2:

TABLE 2. VARIATIONS IN ESTIMATES PLACED BY 95 FARM OPERATORS ON THE VALUE OF THEIR TIME FOR TWELVE MONTHS

Value of operator's labor	Number of farms	Per cent
$ 300	1	1.0
600	4	4.2
700	2	2.1
720	7	7.4
750	2	2.1
800	7	7.4
840	2	2.1
900	22	23.2
960	3	3.2
990	1	1.0
1,000	17	17.9
1,074	1	1.0
1,080	1	1.0
1,120	1	1.0
1,200	20	21.1
1,500	3	3.2
2,500	1	1.0
Total	95	

The average monthly wage paid to hired men without board in 1923 was $68 (table 3). The average monthly wage paid to hired men with board was $41 and the cost of the part of the board that was purchased averaged $17.

TABLE 3. LABOR ON 95 FARMS IN 1923

	Number of farms using	Months worked			Value of unpaid labor		Total wages		Average per month worked	
		Total	Per cent	Per farm	Total	Average per month	Cash	Board	Cash	Board
Operator's wife:										
Unpaid	46	151.5	11.1	3.3	$7,849	$ 51.81	...	...	...	
Operator's sons:										
Paid	1	18.0	1.3	18.0	...	...	$ 540	$ 360	$30.00	$20.00
Unpaid	28	193.8	14.1	6.9	9,225	47.60	...	...	...	...
Operator's daughter:										
Unpaid	1	0.3	...	0.3	30	100.00	...	...		...
Operator's other relatives:										
Paid	5	48.0	3.5	9.6	...		1,535	715	31.98	14.90
Unpaid	14	104.0	7.6	7.4	5,335	51.30	...	...	...	...
Hired men by month, without board	22	199.5	14.6	9.1	...	...	13,650	...	68.42	...
Hired men by month, with board	50	513.6	37.5	10.3	...	...	21,133	8,926	41.15	17.38
Hired men, board only	1	12.0	0.9	12.0	...	...	...	180	...	15.00
Hired men by day:										
Without board	58	105.2	7.7	1.8		...	9,940	...	94.49	...
With board	16	21.9	1.6	1.4	...	...	1,462	310	66.76	14.16
Other help	1	2.0	0.1	2.0	...	...	108	...	54.00	.
Total labor, except operator	94	1,369.8	100.0	14.6	$22,439	$49.91	$48,368	$10,491	$53.26	$17.10
Operator	95	1,122.0	...	11.8	$91,790	$81.81	...	...	...	.
Son's time as operator	1	6.0	...	6.0	240	40.00	...	...	...	
Brother's time as operator	1	2.0	...	2.0	120	60.00	...	...	...	...
Hired man's time as operator	2	10.0	...	5.0	714	71.40	...	.	...	
Total for 12 months time, operator	95	1,140.0	.	12.0	$92,864	$81.46	..	.	.	
Man equivalent	...	...	...	2.22	.		...	...		...

The average number of persons engaged in operating these farms was 2.22 per farm, practically the same as for the two preceding years. Of the total months of labor, 45.4 per cent was time spent by the operator, 20.6 per cent by other members of the operator's family, and the remaining 34 per cent by other persons. Two-thirds of the labor on these farms is done by the operator and his family.

The details of labor on the 95 farms in 1923 are given in table 3.

FARM CAPITAL

The average size of 95 farms was 162.8 acres, with 59.2 acres, or 36 per cent of the total, in crops. An average of 74.9 acres per farm was in permanent pasture, of which 34.4 acres were considered by the farmers to be tillable. The total area of pasture per farm, determined by reducing the woods pastured to their equivalent in open pasture, was 78 acres. (Table 4.)

TABLE 4. AVERAGE SIZE OF 95 FARMS

	Average acres per farm	Per cent of total acres
Crop land	59.2	36.4
Woods pastured*	11.5	7.1
Rotated pasture	0.7	0.4
Permanent pasture tillable	34.4	21.1
Other permanent pasture	40.5	24.9
Woods not pastured	10 7	6 6
Farmstead, roads, and so forth	5.8	3.5
Total	162 8	100 0

* Equivalent to 2.4 acres of open pasture.

The capital per farm averaged $15,546, of which 67.4 per cent was in real estate, 25.1 per cent was in livestock, and 7.5 per cent was in machinery and supplies (table 5). The capital per farm was slightly less than the average for the preceding year.

TABLE 5. AVERAGE CAPITAL FOR 95 FARMS

	Value per farm	Per cent of total
Real estate	$10,476	67.4
Livestock	3,909	25.1
Machinery	1,148	7.4
Feed and supplies	13	0.1
Total	$15,546	100 0

FARM RECEIPTS

Of the total income from these farms, 56.3 per cent was cash for milk sold, 2 per cent was in certificates of indebtedness of the Dairymen's

League Cooperative Association, Inc., 13 per cent was in livestock sold, 19.6 per cent was from crops sold, and 9.1 per cent was from miscellaneous sources. The total receipts per farm were $5247, $697 more than for the year 1922. The data are given in table 6:

TABLE 6. AVERAGE RECEIPTS PER FARM

	Average per farm	Per cent of total
Crops sold	$1,027	19.6
Livestock sold	682	13.0
Milk sold:		
Cash	2,956	56.3
Certificates of indebtedness	105	2.0
Miscellaneous	477	9.1
Total	$5,247	100.0

CROPS

The crops grown, the total yield, and the receipts for crops sold, are shown in table 7:

TABLE 7. CROPS RAISED ON 95 FARMS

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Corn for grain	24 1	1,037	Bushels	...	...	...	...
Stover from corn for grain	...	11	Tons	...		...	...
Corn for the silo	803	9,470	Tons	5	$ 20	5	$ 20
Corn for fodder	3	3	Tons		...	...	...
Corn fed green	12.5	159	Tons	...	...	...	...
Oats	504 8	18,878	Bushels	281	246	100	50
Oat straw		380	Tons	3.5	23	3	20
Oats and barley	141 5	5,279	Bushels	...		...	...
Oat and barley straw	...	116	Tons	...	...	...	...
Oats and peas	3	150	Bushels	...	...	...	...
Barley	103	3,485	Bushels	127	215	...	...
Barley straw	...	75	Tons	3	30	...	...
Buckwheat	20 5	529	Bushels	205	179		...
Buckwheat straw	...	7	Tons		...	...	...
Winter wheat	39	1,274	Bushels	244 5	301	115	132
Spring wheat	3	70	Bushels	...	...	...	...
Wheat straw	...	40 5	Tons	...	...	...	...
Rye	2	70	Bushels	35	52	35	52
Rye straw	...	1	Tons	...	...	...	...
Oats for hay	90	132	Tons	...	...		...
Oats and peas for hay	8 5	17	Tons	...	...	...	...
Oats, peas, and barley for hay	2	4	Tons	...	...	...	...
Barley for hay	1	2	Tons			...	...
Buckwheat for hay	5	4	Tons	...	...	...	...
Vetch for hay	4	10	Tons	...	...	...	...
Oats fed green	6	15	Tons	...	...	...	...
Oats and barley fed green	2	5	Tons	...	...	...	...
Oats and peas fed green	5 3	29	Tons	...	...	...	...
Oats and buckwheat fed green	4	12	Tons	...	...	...	...
Oats and millet fed green	2	2	Tons	...	...		...
Buckwheat fed green	1.5	15	Tons	...	...	...	...
Millet fed green	1 5	11	Tons		...	...	...
Sudan grass fed green	1.3	10	Tons		...	...	...
Alfalfa fed green, second cutting*	(9)	13	Tons	...	...	...	...
Alfalfa for the silo	6	43	Tons	...	...	...	...
Mixed hay (clover) fed green	10	15	Tons	...	...	...	...
Rowen fed green *	(12)	22	Tons	...	...	...	...

* These acres are not included in the total acres of crops.

TABLE 7 (*concluded*)

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Alfalfa, first cutting	153	307.5	Tons	5	$ 75	.....	.....
Alfalfa, second cutting *	(144)	100	Tons	6	90	6	$ 90
Alfalfa, third cutting *	(21)	14	Tons	.....	.....	.....	.....
Mixed hay (clover)	809	1,740	Tons	72.2	985	8.5	102
Mixed hay (other)	1,409	2,288	Tons	93.2	1,213	19.5	243
Timothy	840.5	1,473	Tons	230	3,276	59	823
Rowen *	(84)	46	Tons	.....	.....	.....	.....
Swamp hay	35	45	Tons	.....	.....	.....	.....
Millet	2	8	Tons	.....	.....	.....	.....
Potatoes	100.1	13,898	Bushels	7,012	6,213	414	318
Cabbage	237.8	2,750.5	Tons	2,429	36,334	187.5	2,493
Cabbage refuse	.....	445	Tons	.....	10	.....	.....
Market peas	198.5	25,236	Bushels	17,854.5	30,561	6,675.5	11,517
Peavines, cured	.....	18	Tons	.....	.....	.....	.....
Peavines, green	.....	8	Tons	.....	.....	.....	.....
Peavine silage *	(3)	8	Tons	.....	.....	.....	.....
Field beans	4.4	20	Bushels	38	176	.....	.....
Bean refuse, cured *	(3)	0.5	Tons	.....	.....	.....	.....
Beets and mangels	4.9	73.8	Tons	3.5	111	.....	.....
Turnips	1	8	Tons	.....	.....	.....	.....
Cucumbers	0.7	75	Bushels	44	94	29	56
Parsnips	.....	.....	Bushels	8	12	.....	.....
Pumpkins	2	.....	Tons	21.6	103	.....	.....
Cauliflower	.....	.....	Dozen	12	16	.....	.....
Hubbard squash	0.4	7	Tons	.....	.....	.....	20
Strawberries	0.1	.....	Quarts	200	30	.....	.....
Apples †	11	.....	Barrels	297	792	38	115
Garden	5.7	.....	.....	.....	.....	.....	.....
1922 oat straw	.....	.....	Tons	6	39	.....	.....
1922 mixed hay (other)	.....	.....	Tons	25	300	.....	.....
Total	5,624.6	.....	.....	.....	$81,496	.....	$16,051

* These acres are not included in the total acres of crops.
† Most of the orchards of this area consisted of scattered trees, and the yields were not ascertained.

Of the total crop acres, 15 per cent was in corn crops, 15.5 per cent in oats and barley, 9.5 per cent in cabbage, potatoes, and market peas, and the remainder, 60 per cent, in hay and small acreages of miscellaneous

TABLE 8. AVERAGE YIELDS PER ACRE FOR IMPORTANT CROPS IN 1923

	Unit	Yield per acre
Corn for the silo	Tons	11.8
Corn for grain	Bushels	43.0
Oats for grain	Bushels	37.4
Oats for hay	Tons	1.5
Oats and barley for grain	Bushels	37.3
Barley	Bushels	33.8
Buckwheat for grain	Bushels	25.8
Winter wheat	Bushels	32.7
Alfalfa cured, first cutting	Tons	2.0
Alfalfa cured, second cutting	Tons	0.8
Alfalfa cured, third cutting	Tons	0.7
Mixed hay (clover)	Tons	2.2
Mixed hay (other)	Tons	1.6
Timothy	Tons	1.8
Potatoes	Bushels	138.8
Cabbage	Tons	11.6
Market peas	Bushels	127.1

crops. There was no decrease from the preceding year in the proportion of corn crops and spring grains, but the cultivated cash crops were reduced and more of the land was left in hay.

The average yields per acre for some of the crops in 1923 were: corn for the silo, 11.8 tons; oats threshed, 37.4 bushels; mixed hay (clover), 2.2 tons; other mixed hay, 1.6 tons; potatoes, 138.8 bushels; market peas, 127.1 bushels; cabbage, 11.6 tons (table 8). The crop index, or number that represents the relative yield of crops in this area as compared with the average yield of the same crops in New York State, was 135 for the crop year 1923. That for the preceding year was 126. Yields of crops were somewhat better in 1923 than in 1922. In 1923, the average index for corn for the silo was 190 per cent, for oats 113 per cent, and for hay 126 per cent, of the state average. If the indexes of corn for the silo, oats, and hay are weighted according to the percentage of work units spent on each crop, the net weighted index for these crops is 154.

The varieties of corn for the silo grown in 1923 on the 95 farms are given in table 9; of the total acreage, more than half is West Branch and Sweepstakes. Luce's Favorite is losing each year in popularity as an ensilage corn, and Sweepstakes is gaining very rapidly.

TABLE 9. VARIETIES OF CORN FOR THE SILO, 95 FARMS

Variety	Acres	Per cent
Sweepstakes	214.5	26.7
West Branch	214.0	26.7
Luce's Favorite	145.3	18.1
Leaming	72.5	9.0
Eureka	51.2	6.4
Pride of Nishua	29.0	3.6
Golden Ensilage	12.0	1.5
State Corn	7.0	0.9
Cornell No. 11	6.0	0.7
White Dent	4.0	0.5
Bloody Butcher	4.0	0.5
Pride of the North	2.0	0.2
World's Wonder	1.5	0.2
Big Crop	1.0	0.1
Kinds not found	39 0	4.9
Total	803.0	100.0

LIVESTOCK

Statements of the inventories, sales, purchases, and deaths of cattle and other livestock appear in tables 10 and 11. The average numbers of the more important animals per farm were: cows, 22.3; heifers one year or older, 5.6; heifers under one year, 4.2; bulls, 1; horses and mules, 3.6; chickens, 124.

The total number of animal units per farm was 33.3, or of animal units excluding work animals 29.7. Of the cows on hand, 37.9 per cent were purebred. The proportion of purebred cows has gradually increased each year. Of the heifers one year old or over, 56.7 per cent were pure-

TABLE 10. APPRECIATION AND DEPRECIATION ON CATTLE, 95 FARMS

	Cows						Heifers											
	Grade			Purebred			Grade						Purebred					
							One year or over			Under one year			One year or over			Under one year		
	Number of farms	Number of cows	Value	Number of farms	Number of cows	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number farms	Number of heifers	Value
On hand May 1, 1923	74	1,305	$106,524	55	799	$135,385	53	207	$8,715	53	202	$4,533	42	284	$31,880	43	259	$16,875
Purchased during year	36	260	22,938	8	40	4,920	8	24	855	6	9.5	111	2	4	297	1	8	616
Born during year										43	155	515				35	192	3,670
Heifers that became cows	49	146	9,428	35	172	21,805												
Total			$138,890			$162,110			$9,570			$5,159			$32,177			$21,161
Sold	50	352	$23,830	34	180	$19,861	7	17	$790	3	17.5	$424	12	39	$3,102	8	23	$1,380
Died or killed by accident	19	23		15	19*	150	1	1		1	1		5	5		2	3	
Hides sold	10	14	43	8	10	32	1	1	3									
Heifers that became cows							49	146	9,428				35	172	21,805			
Used for food	9	10	395	5	4	178	2	2	90	1	1	12						
On hand May 1, 1924	75	1,326	102,910	56	808	125,106	57	254	10,576	44	158	3,050	45	319	35,291	35	186	11,836
Total			$127,178			$145,327			$20,887			$3,486			$60,198			$13,216
Appreciation							$29,720											
Depreciation	$28,495																	

* Including one killed by lightning, indemnity $150.

TABLE 10 (*concluded*)

	Herd bulls						Veals			Bull calves to be sold		
	Grade			Purebred								
	Number of farms	Number of bulls	Value	Number of farms	Number of bulls	Value	Number of farms	Number of veals	Value	Number of farms	Number of bull calves	Value
On hand May 1, 1923	17†	19.5	$896	62‡	68.1	$12,873	3	5	$ 59	4	11	$925
Purchased during year	9	9	241	18	17	986	1	6	21	1	1	5
Born during year	5	6	19	11	12	178	94	1,551	4,338	8	33	730
Heifers that became cows	......	......	......	......	......	......	......	......	......	......	......	......
Total	......	......	$1,156	......	......	$14,037	......	......	$4,418	......	......	$1,660
Sold	8	9	$303	28	25.7	$2,336	94§ { 18 90	157 1,400	$1,433 3,942	9	30	$1,213
Died or killed by accident	1	0.5	......	1	0.5	......	......	......	......	......	......	......
Hides sold	......	......	......	1	1	3	1	1	1	......	......	......
Heifers that became cows	......	......	......	......	......	......	......	......	......	......	......	......
Used for food	......	......	......	1	1	25	1	1	15	......	......	......
On hand May 1, 1924	27†	25	826	56‡	69.9	9,100	1	4	48	8	15	1,430
Total	......	......	$1,129	......	......	$11,464	......	......	$5,439	......	......	$2,643
Appreciation	......						$1,021			$983		
Depreciation	$2,600						......			......		

† Two farms had 2 grade bulls for keep, value not included.
‡ One farm had 1 purebred bull for keep, value not included.
§ 18 farms sold 157 fat veals, and 90 farms sold 1,400 veals at birth.

TABLE 11. SUMMARY OF LIVESTOCK OTHER THAN DAIRY CATTLE

	Inventory at beginning of year			Purchases			Sales			Inventory at end of year			Died		Used for food		
	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Number of farms	Number of head	Value
Horses	95	337	$46,210	11	16	$1,968	7	12	$1,253	95	331	$41,779	9	13*	......	......	......
Colts	9	15	1,440	1	2	95	1	1	22	7	14	1,185	......	......	......	......	......
Mules	3	5	725	1	1	100	......	......	......	3	6	825	......	......	......	......	......
Stallions	2	2	450	......	......	......	......	......	......	2	2	450	......	......	......	......	......
Ponies	1	1	25	......	......	......	......	......	......	1	1	25	......	......	......	......	......
Sheep, ewes	2	104	863	......	......	......	2	44	304	2	52	440	2	8	......	......	......
Lambs, weaned	1	10	30	......	......	......	2	45	440	1	18	72	......	......	......	......	......
Sheep, bucks	1	1	10	......	......	......	1	1	10	......	......	......	......	......	......	......	......
Brood sows	9	15	408	3	4	80	3	4	93	7	11	356	......	......	8	8	$ 281
Other hogs	9	18	416	15	24	196	7	7.5	201	20	33	631	......	......	24	39 5	1,118
Pigs, weaned	2	4	45	13	28	164	5	34	173	2	5	87	3	3	......	......	......
Chickens	86	10,996	13,740	12	2,773	1,947	43	4,874	3,208	88	12,546	13,007	......	......	......	......	......
Baby chicks	......	......	......	27	8,260	1,196	3	2,912	473	1	220	42	......	......	......	......	......
Turkeys	2	10	53	1	2	7	1	2	7	2	11	66	......	......	......	......	......
Bees†	4	39	305	......	......	......	......	......	......	4	62	286	......	......	......	......	......
Total	......	......	$64,720	......	......	$5,753	......	......	$6,184	......	......	$59,251	......	......	......	......	$1,399

* Two horsehides sold for $6, on two farms.

† Four farms had 39 colonies of bees at the beginning of the year, and 62 colonies at the end of the year.

TABLE 12. Returns from Milk Sold, 95 Farms

	Milk pooled*								Milk not pooled					
					Amount received by farmers for milk									
	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butter-fat	Certificates of indebtedness	Cash	Total	Total per 100 pounds	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butter-fat	Amount dealer paid for milk	Amount received by farmer per 100 pounds
1923:														
May (pasture)	......	555,852	18,960	......	$ 556	$10,192	$10,748	....	......	64,661	2,185	......	$1,363	....
May (winter)	......	634,996	21,497	......	635	11,716	12,351	....	......	89,271	2,986	......	1,864	....
June (pasture)	......	1,186,997	39,030	......	1,187	22,344	23,531	....	......	147,146	4,854	......	3,209	....
June (winter)	......	2,661	84	......	3	46	49	....	......	2,663	84	......	53	....
May (total)	84	1,190,848	40,457	3.4	1,191	21,908	23,099	$1.94	11	153,932	5,171	3.4	3,227	$2.10
June (total)	85	1,189,658	39,114	3.3	1,190	22,390	23,580	1.98	11	149,809	4,938	3.3	3,262	2.18
July	85	936,218	31,085	3.3	1,404	17,923	19,327	2.06	11	107,177	3,592	3.4	2,465	2.30
August	86	766,569	26,072	3.4	766	15,842	16,608	2 17	10	75,118	2,636	3.5	1,890	2.52
September (pasture)	......	783,215	26,926	......	783	17,479	18,262	....	......	82,438	2,818	......	2,341	....
September (winter)	......	2,690	89	......	3	56	59	....	......	2,664	93	......	70	....
October (pasture)	......	592,478	20,448	......	592	14,091	14,683	....	......	61,309	2,131	......	1,785	....
October (winter)	......	344,479	11,689	......	345	8,059	8,404	....	......	41,756	1,428	......	1,188	....
November (pasture)	......	36,528	1,214	......	36	899	935	....	......	....	....	......	....	....
November (winter)	......	967,149	32,456	......	967	22,494	23,461	....	......	97,876	3,282	......	2,643	....
September (total)	86	785,905	27,015	3 4	786	17,535	18,321	2 33	10	85,102	2,911	3 4	2,411	2.83
October (total)	86	936,957	32,137	3.4	937	22,150	23,087	2.46	10	103,065	3,559	3.5	2,973	2.88
November (total)	86	1,003,677	33,670	3.4	1,003	23,393	24,396	2.43	10	97,876	3,282	3.4	2,643	2.70
December	86	1,077,659	36,212	3.4	538	23,630	24,168	2.24	10	117,361	3,863	3 3	3,040	2.59
1924:														
January	86	1,114,099	36,977	3.3	557	22,055	22,612	2.03	10	125,229	4,078	3.3	2,936	2.35
February	86	1,040,472	35,150	3.4	520	19,655	20,175	1.94	9	101,057	3,315	3.3	2,326	2 30
March	87	1,134,800	37,874	3.3	567	20,919	21,486	1.89	9	111,072	3,703	3.3	2,505	2.25
April	83	1,091,359	36,649	3.4	546	19,772	20,318	1.86	13	156,784	5,277	3.4	3,469	2.21
Total:														
Pasture	......	4,857,857	163,735	3.4	$5,324	$98,770	$104,094	$2.14	......	537,849	18,216	3.4	$13,053	$2 43
Winter	......	7,410,364	248,677	3.4	$4,681	$148,402	$153,083	$2.07	......	845,733	28,109	3.3	$20,094	$2.38
Year	......	12,268,221	412,412	3.4	$10,005	$247,172	$257,177	$2.10	......	1,383,582	46,325	3.3	$33,147	$2.40

* Milk pooled is that sold thru the Dairymen's League Cooperative Association, Inc. The buyers paid the Cooperative Association directly for this milk, and the producers received the net pool price paid by the Association. The "Amount dealer paid for milk" represents the money which buyers paid directly to farmers not affiliated with the Cooperative Association.

bred, and of the heifers under one year, 55.3 per cent were purebred. Of the herd bulls, 75.6 per cent were purebred. There has been no increase in the proportion of registered young cattle and bulls. The appreciation on cattle was $106 per farm in 1923, $395 per farm in 1922, and $528 per farm in 1921. The depreciation on horses was $57 per farm, or 12.1 per cent of their average value.

MILK SOLD

Receipts from milk sold in 1923 are shown in table 12. Of the total milk sold during the year 90 per cent was sold thru the Dairymen's League Cooperative Association, Inc. The proportion of milk sold thru the Cooperative Association has increased each year in this area.

The monthly distribution of the production of milk, the average butterfat test, and the monthly receipts per farm from milk sold, are given in table 13. The butterfat test for the year averaged 3.4, but varied from 3.3 to 3.4.

TABLE 13. Distribution of Milk Production, 95 Farms

	Total pounds of milk sold wholesale	Per cent	Butter-fat test	Value per farm including certificates of indebtedness
1923:				
May	1,344,780	9.9	3.4	$277
June	1,339,467	9.8	3.3	283
July	1,043,395	7.6	3.3	229
August	841,687	6.2	3.4	195
September	871,007	6.4	3.4	218
October	1,040,022	7.6	3.4	274
November	1,101,553	8.1	3.4	285
December	1,195,020	8.7	3.4	286
1924:				
January	1,239,328	9.1	3.3	269
February	1,141,529	8.4	3.4	237
March	1,245,872	9.1	3.3	253
April	1,248,143	9.1	3.4	250
Total	13,651,803	100.0	3.4	$3,056
Total pasture	5,395,706	39.5	3.4	$1,233
Total winter	8,256,097	60.5	3.4	$1,823

The average pool price paid to farmers for milk sold to the Dairymen's League Cooperative Association, Inc., was $2.10 for the year 1923, comprising 8 cents in the form of certificates of indebtedness, and $2.02 cash. This price was 3 cents more per 100 pounds than in the preceding year, and 10 cents more per 100 pounds than in 1921. The price received for milk not sold thru the Cooperative Association was $2.40 per 100 pounds, which was 34 cents per 100 pounds more than the price paid by the Association for milk of the same butterfat test. The difference between the pool price and the price for milk sold directly to dealers in 1922 was 42 cents

per 100 pounds, and in 1921 it was 37 cents per 100 pounds. In addition to the pool price given in tables 12 and 13, 0.3 cent per 100 pounds was returned to the poolers to cover unpaid amounts from April 1, 1923, to March 31, 1924. All pool prices and gain or loss figures in this bulletin should be corrected by this amount.

MISCELLANEOUS RECEIPTS

The miscellaneous farm receipts are given in table 14. The average amount of income per farm from miscellaneous sources was $477. There has been an increase in the income from eggs, of about $100 per farm in the past three years. This is the chief item to which the increase in miscellaneous receipts is due.

TABLE 14. MISCELLANEOUS RECEIPTS, 95 FARMS

	Amount		Price	Value		
				Farm	Operator	Landlord
Human labor off farm	598	days	$ 3.44	$ 2,058	$ 2,016	$ 42
Association work[1]	....		....	2,400	2,400	....
Horse labor off farm	553	days	1.29	713	702	11
Use of machinery	358	days	1.89	676	667	9
Use of pasture	....		....	309	309	....
Maple sirup	579	gallons	2.03	1,176	1,072	104
Maple sugar	34	pounds	0.35	12	12	....
Honey	1,300	pounds	0.30	390	370	20
Lumber	98.8	thousand feet	34.83	3,441	3,379	62
Wood	329	cords	4.08	1,342	1,217	125
Gravel	....		....	797	797	....
Sand	....		....	81	81	....
Eggs	81,026.5	dozen	0.32	26,049	25,259	790
Wool	522	pounds	0.47	244	244	....
Feed bags	16,121		0.04	571	544	27
Hauling milk	....		....	136	136	....
Premiums at fair	....		....	255	255	....
Hides	46		2.26	104	99	5
Insurance	....		....	3,100	3,100	....
Lightning indemnity	1		150.00	150	150	....
Ice	3,200	cakes	0.05	160	160	....
Cabbage plants	39,000		1.49	58	58	....
Board of horses	....		....	48	....	48
Breeding fees	....		....	262	250	12
Rent of house	....		....	270	270	....
Miscellaneous	....		....	510	510	....
Total	....		....	$45,312	$44,057	$1,255
Per farm	....		....	$477	$464	$13

[1] Some operators worked for cooperative associations.

FARM EXPENSES

The operating expenses per farm amounted to $3509, of which the cattle and horse feed was 33 per cent, labor 24 per cent, taxes 6 per cent, new machinery and repairs to machinery 6 per cent, and other items 31 per cent (table 15).

TABLE 15. FARM EXPENSES ON 95 FARMS

	Value		
	Total	Per farm	Per cent
Labor, hired	$ 48,368	$ 509	14.5
Labor, unpaid	22,439	236	6.7
Board of hired labor	10,491	110	3.1
Advertising	157	2	0.1
Baling	65	1	......
Barrels, baskets, crates, etc	3,921	41	1.2
Bedding	1,390	15	0.4
Breeding fees	127	1	......
Building repairs	7,980	84	2.4
Pasturage	1,122	12	0.3
Commissions, storage	4,083	43	1.2
Freight and express	7,587	80	2.3
Salt	966	10	0.3
Hay, silage, straw, stalks	1,905	20	0.6
Poultry and hog feed	16,422	173	4.9
Cattle and horse feed	109,092	1,148	32.7
Grinding feed	735	8	0.2
Fence, wire, posts, staples, etc	1,400	15	0.4
Fertilizer	7,561	80	2.3
Lime	2,123	22	0.6
Horseshoeing	3,125	33	0.9
Insurance	4,142	44	1.3
Sawing lumber	722	8	0.2
Machinery, new	17,730	187	5.3
Repairs on machinery	3,024	32	0.9
Machinery hired	255	3	0.1
Filling silo	1,628	17	0.5
Threshing	1,790	19	0.5
Coal, oil, gasoline, for farm use	4,103	43	1.2
Twine	768	8	0.2
Farm share of upkeep and operation of automobile	5,398	57	1.6
Ice, and sawdust for ice	367	4	0.1
Hauling milk	1,196	13	0.4
Milk bottles, cans, strainers, etc	483	5	0.2
Cow tester, acid, fees, etc	972	10	0.3
Registration fees	426	4	0.1
Dairymen's League News	80	1	......
Grass seed	3,998	42	1.2
Other seeds and plants	5,461	57	1.6
Spray materials	516	5	0.2
Stamps, stationery, for farm use	231	2	0.1
Telephone, farm use	1,980	21	0.6
Electricity and carbide	1,542	16	0.5
General property taxes	13,201	139	4.0
School taxes	6,171	65	1.9
Veterinary, medicines, etc	2,553	27	0.8
Water system	330	3	0.1
Any other farm expense	3,199	34	1.0
Total (except cash rent and new buildings)	$333,325	$3,509	100.0
Cash rent	1,921	....	......
New buildings	7,954	84	......
Operator	(6,720)	....	......
Landlord	(1,234)	....	......
Total	$343,200	....	......

TABLE 15 (*concluded*)

	Value		
	Total	Per farm	Per cent
Livestock purchased	$36,743	$387	......
Operator	(32,248)	....	......
Landlord	(4,495)	....	......
Decrease in inventory	10,217	107	......
Total except cash rent	$388,239	$4,087	......

The expenses for new buildings amounted to $84 per farm, and for livestock purchased to $387 per farm. In addition to these items of expense there was a decrease of inventory averaging $107 per farm, which, when added to the current operating expenses of $3509 per farm, makes a total expense of $4087 per farm.

LABOR INCOMES

The total receipts on these farms were $5247, and the total expenses $4087. The difference, or farm income, was thus $1160. The interest on $15,546 at 5 per cent amounted to $777, leaving $383 as the average labor income of the operator for the year 1923. The labor income averaged $32 in 1922, and $321 in 1921, on the same group of farms.

The net income can be expressed in terms of interest on the investment, by deducting from the farm income of $1160, the value of the operator's time, $978, leaving $182, which represents 1.2 per cent return on the capital.

The labor income as found by recalculating the milk receipts at pool prices paid by the Dairymen's League Cooperative Association, Inc., was $336, in contrast to $383 as actually received.

The average cash living costs of 95 farm operators were $357 for food, $183 for clothing, and $174 for other expenses, making a total of $714 per farm, or $60 per month. The amount spent for living averaged $68 per month in 1921, and $62 per month in 1922. The cash living costs were 3.4 per cent less than in the preceding year.

COSTS AND RETURNS IN PRODUCING MILK

The items of cost in producing milk are as follows: concentrates, succulent feed, dry forage, pasture, bedding, labor, hauling milk, use of buildings, use of equipment, interest, depreciation on cows, bull service, and miscellaneous charges. The returns are for milk and milk products, calves born during the year, manure, and miscellaneous items.

COSTS

Concentrates

The average value of home-grown concentrates was $36.62 per ton, of purchased concentrates $42.50 per ton, and of all concentrates used $41.66 per ton. The average price of concentrates was the same as for the preceding year. Of the total grains and concentrates used by cattle

TABLE 16. CONCENTRATES USED BY 2142 COWS, 934 HEIFERS, 91 HERD BULLS, AND 340 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (cwt.)	Average price per ton	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value
Home-grown:													
Corn for grain	166	$36.27	$ 301			117	$ 219					49	$ 82
Oats	5,124	36.14	9,258			567	1,024	270	$475	34	$71	4,253	7,688
Oats and barley	1,849	36.22	3,349			279	529	96	178	5	10	1,469	2,632
Oats and peas	69	40.00	138			29	58					40	80
Barley	1,274	39.17	2,495			755	1,494	25	40	5	8	489	953
Winter wheat	42	31.90	67			36	59	3	4			3	4
Total home-grown	8,524	$36.62	$15,608			1,783	$3,383	394	$697	44	$89	6,303	$11,439
Purchased:													
Cornmeal	1,773	$ 40.23	$ 3,566	15	$ 30	752	$ 1,524	330	$ 668	54	$110	622	$1,234
Hominy	4,591	38.17	8,763	1,170	2,129	2,121	4,112	911	1,753	91	173	298	596
Whole corn	111	38.02	211									111	211
Cracked corn	50	40.00	100									50	100
Whole oats	267	33.93	453					95	152			172	301
Ground oats	3,119	38.95	6,075	181	352	1,200	2,326	766	1,508	97	191	875	1,698
Ground corn and oats	186	41.94	390					9	19	15	30	162	341
Molasses	168	31.43	264	20	30	120	191	21	32			7	11
Wheat bran	2,728	34.99	4,773	315	545	1,292	2,257	824	1,422	49	89	218	460
Wheat middlings	52	38.08	99			10	19	31	58	11	22		
Wheat feed	1,137	38.45	2,186	53	119	730	1,392	236	459	49	90	69	126
Gluten feed	5,807	42.97	12,475	1,060	2,268	4,242	9,112	422	914	43	94	40	87
Cottonseed meal	118	59.66	352	13	37	86	258	16	49	3	8		
Oilmeal	2,906	46.33	6,732	302	697	1,822	4,207	701	1,636	42	99	39	93
Calf meal	6	106.67	32					6	32				
Madison Cooperative Milk Maker	13,940	45.09	31,426	2,564	5,716	10,854	24,557	475	1,046	47	107		
Gainesmore Ration	5,082	43.72	11,109	924	2,041	3,961	8,645	147	317	50	106		
Tioga Red Brand	1,839	43.01	3,955	52	109	1,665	3,583	122	263				
G. L. F. Ration	1,052	46.31	2,436			963	2,233	80	183	9	20		
Armour's Dairy Ration	910	44.18	2,010	25	57	835	1,853	50	100				
G. L. F. Milk Maker	820	46.54	1,908			784	1,826	28	63			8	19
Farmers' Syndicate Ration	486	47.37	1,151	60	136	304	718	104	256	18	41		
3 M	400	46.40	928			400	928						
Sweet 16*	390	33.54	654	142	229	100	186	108	175	25	40		
Cloverleaf Special	350	37.03	648	220	407	90	167	40	74				
Beet pulp *	330	41.21	680			319	658	10	20				
Alinco	289	47.34	684			274	646	15	38				
Brewers' dried grains	250	36.64	458			250	458						
Malt grains	240	37.25	447			240	447						
Larro	236	53.81	635	184	492	52	143						
Monarch	223	41.97	468	20	42	81	170	50	105	12	25	60	126
Wallkil	200	45.00	450	50	113	136	305	9	20			5	11

Advanced Registry	100	48.40	242	......	......	100	242	......	......	......	......	......	......
Direct	100	45.00	225	......	......	100	225	......	......	......	......	......	......
Madison Cereal Feed	100	23.00	115	22	25	60	69	17	19	1	2	......	......
Schumacher	85	42.82	182	18	38	37	78	22	48	8	18	......	......
Madison Vim	60	45.00	135	15	34	15	34	30	67	......	......	......	......
Burnt Cereal	49	24.90	61	......	......	49	61	......	......	......	......	......	......
Diamond Gluten Meal	26	58.46	76	......	......	16	48	5	15	2	4	3	9
Madison Cooperative Gold Medal	15	30.67	23	......	......	......	......	......	......	15	23	......	......
Other mixed feeds (kinds not found)	744	40 73	1,515	147	317	424	859	124	248	8	15	41	76
Total purchased*	51,335	$42 50	$109,092	7,572	$15,963	34,484	$74,538	5,804	$11,750	649	$1,307	2,810	$5,499
Total concentrates*	59,859	$41 66	$124,700	7,572	$15,963	36,267	$77,921	6,198	$12,456	693	$1,396	9,113	$16,938

* Bull calves to be sold were fed 15 hundredweight of Sweet 16, valued at $24, and 1 hundredweight of beet pulp, valued at $2.

TABLE 17. SUCCULENT FEED USED BY 2142 COWS, 934 HEIFERS, AND 91 HERD BULLS

Kind of feed	Total			Cows				Heifers		Herd bulls	
				Pasture period		Winter period					
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home grown:											
Corn silage	9,030	$ 5.29	$47,768	127.5	$671	7,625.7	$40,342	1,113	$5,887	163.8	$868
Corn silage, 1922	191	5.29	1,010	101	534	90	476				
Peavine silage	8	5.00	40			8	40				
Alfalfa silage	43	5.00	215			43	215				
Corn	159	4.91	780	159	780						
Potatoes	8.9	23.15	206			8.9	206				
Cabbage	78	9.23	720			78	720				
Cabbage refuse	435	3.55	1,543	83	380	330	1,113	22	50		
Turnips	8	6.25	50			8	50				
Beets and mangels	53.3	9.81	523	5.5	55	47.3	463	0.5	5		
Peavines	8	3.00	24	8	24						
Hubbard squash	7	10.00	70			7	70				
Oats	15	4.67	70	15	70						
Oats and peas	29	5.24	152	29	152						
Oats and barley	5	5.00	25	5	25						
Oats and buckwheat	12	6.00	72	12	72						
Oats and millet	2	5.00	10	2	10						
Buckwheat	15	2.53	38	15	38						
Millet	11	3.18	35	11	35						
Sudan grass	10	2.80	28	10	28						
Alfalfa, second cutting	13	6.38	83	13	83						
Mixed-hay rowen	15	5.00	75	15	75						
Timothy rowen	22	3.09	68	22	68						
Total home-grown	10,178.2	$5.27	$53,605	633	$3,100	8,245.9	$43,695	1,135.5	$5,942	163.8	$868
Purchased:											
Silage	18	$5.56	$100			18	$100				
Total purchased	18	$5.56	$100			18	$100				
Total succulent feed	10,196.2	$5.27	$53,705	633	$3,100	8,263.9	$43,795	1,135.5	$5,942	163.8	$868

TABLE 18. DRY FORAGE USED BY 2142 COWS, 934 HEIFERS, 91 HERD BULLS, AND 340 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Alfalfa, first cutting	302.5	$15.71	$ 4,753	1	$ 20	267.5	$ 4,243	34	$ 490	...	...	...	...
Alfalfa, second cutting	87	15.90	1,383	1	22	62	994	18	283	6	$ 84	...	...
Alfalfa, third cutting	14	17.64	247	1	22	12	205	1	20	...	...	...	...
Mixed hay (clover)	1,625.3	14.38	23,376	19	279	1,364.2	19,561	165.3	2,397	29.8	439	47	$ 700
Mixed hay (other)	2,082.3	14.29	29,748	9	135	1,199.5	17,032	382	5,594	85.8	1,187	406	5,800
Rowen	46	12.09	556	...	...	32	355	13	187	1	14	...	...
Timothy	1,118	14.58	16,306	27	416	365.5	5,389	245	3,696	44.5	640	436	6,165
Oat hay	130.5	14.22	1,856	...	...	89.5	1,245	2	28	3	45	36	538
Oat and pea hay	17	14.47	246	...	...	17	246	...	...	...	...	...	...
Oat, pea, and barley hay	4	15.00	60	...	...	4	60	...	...	...	...	...	...
Millet	8	5.88	47	4	19	4	28	...	...	...	...	...	...
Barley hay	2	10.00	20	...	...	2	20	...	...	...	...	...	...
Vetch hay	10	15.00	150	...	...	10	150	...	...	...	...	...	...
Swamp hay	41	11.66	478	...	...	29.5	353	7	78	0.5	7	4	40
Total hay	5,487.6	$14.44	$79,226	62	$913	3,458.7	$49,881	867.3	$12,773	170.6	$2,416	929	$13,243
Oat straw	7	$ 5.00	$ 35	...	...	3	$ 15	3	$15	1	$5	...	...
Corn stover	11	6.64	73	...	...	9	56	0.5	4	0.5	4	1	$9
Corn fodder	3	12.00	36	...	...	2.5	30	0.5	6	...	...	...	...
Peavines, cured	18	8.89	160	...	...	18	160	...	...	...	...	...	...
Bean refuse, cured	0.5	20.00	10	...	...	0.5	10	...	...	...	...	...	...
Total straw, stover, etc.	39.5	$7.95	$314	...	...	33	$271	4	$25	1.5	$9	1	$9
Total home-grown	5,527.1	$14.39	$79,540	62	$913	3,491.7	$50,152	871.3	$12,798	172.1	$2,425	930	$13,252
Purchased:													
Mixed hay (clover)	12	$15.00	$ 180	8	$120	...	...	...	...	4	$60	...	...
Mixed hay (other)	119	13.49	1,605	10	150	88.5	$1,153	13.5	$202	...	...	7	$100
Timothy	5	4.00	20	...	...	4	16	...	...	...	...	1	4
Total purchased	136	$13.27	$1,805	18	$270	92.5	$1,169	13.5	$202	4	$60	8	$104
Total dry forage	5,663.1	$14.36	$81,345	80	$1,183	3,584.2	$51,321	884.8	$13,000	176.1	$2,485	938	$13,356

and horses on the 95 farms, 14 per cent was home-grown and 86 per cent was purchased. Of the grain used by horses 69 per cent was home-grown, and of the concentrates used by cows only 4 per cent was home-grown.

The charge for concentrates used in producing milk was $43.83 per cow, or 69 cents per 100 pounds of milk sold. The ration mixed by the Cooperative Feed Store at Earlville was used in larger amounts than any other feed. The straight by-product feeds used in largest amounts were gluten feed, hominy, ground oats, oilmeal, and wheat bran. The kinds and amounts of concentrates used on these farms are shown in table 16.

Succulent feed

The average value per ton placed on corn silage was $5.29. The average value of all succulent feed was $5.27. The data are given in table 17. The charge for succulent feed averaged $21.89 per cow, or 34 cents per 100 pounds of milk sold.

Dry forage

The average value of all hay grown at home and used was $14.41 per ton, and the average value of straw and stover used was $7.95 per ton. The data as to the kinds and the amounts of dry forage used are given in table 18. The charge for dry forage averaged $24.51 per cow, or 39 cents per 100 pounds of milk sold. The chief kinds of hay are mixed hay, predominantly clover, and other mixed grass hay. Very little alfalfa is grown in this region. Cows used 344 tons of alfalfa, or an average of 3.6 tons per farm.

Quantities of feed used

The average pounds of feed used per cow for the year were: concentrates, 2047; succulent feed, 8307; dry forage, 3421. Acres of pasture averaged 3.5 per cow. (Table 19.)

TABLE 19. AMOUNTS OF FEED USED PER COW AND PER UNIT OF PRODUCT, FOR THE YEAR, IN POUNDS

	Per cent of cows freshening from September to December, inclusive						All herds	
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent			
	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced
Concentrates	1,480	27.6	2,093	31.0	2,198	30.4	2,047	30.3
Silage	5,601	104.6	7,262	107.5	8,194	113.4	7,434	110.1
Other succulent feed	507	9.5	643	9.5	1,187	16.4	873	12.9
Dry forage	3,528	65.9	3,100	45.9	3,653	50.6	3,421	50.7
Days of pasture	159	3.0	156	2.3	158	2.2	158	2.3
Acres of pasture	3.2	....	3.4	....	3.6	....	3.5	....

The average quantities of feed used per cow per day and per unit of product during the winter period, and per unit of product during the pasture period, are shown in table 20. In winter dairies, heavier feeding of both concentrates and succulent feed prevails than in herds following the

summer system. In the winter dairies, however, less quantities of all classes of feed are used per unit of product produced in winter, than in the summer dairies. Including the feed used by dry cows, an average of 42 pounds of concentrates, 190 pounds of succulent feed, and 82 pounds of dry forage, were used per 100 pounds of milk produced in the winter period.

TABLE 20. AMOUNTS OF FEED USED PER COW PER DAY, AND PER UNIT OF PRODUCT, IN PASTURE AND WINTER PERIODS, IN POUNDS

	Per cent of cows freshening from September to December, inclusive						All herds		All herds (pasture period) per 100 pounds of milk produced in pasture period
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent				
	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	
Concentrates	6.1	48.0	8.3	43.7	8.7	38.9	8.1	41.6	13.2
Silage	27.1	213.8	33.1	175.3	38.4	172.0	34.7	177.4	8.0
Other succulent feed	1.8	13.8	1.9	10.0	3.0	13.4	2.4	12.2	14.1
Dry forage	17.0	134.7	14.3	75.6	17.2	77.0	16.1	82.2	2.8
Days of pasture	.....	.....	.....	.....	.....	.....	.....	.....	5.9
Acres of pasture	.....	.....	.....	.....	.....	.....	.....	.....	0.13

The average amounts of feed per horse were: concentrates, 2680 pounds; dry forage, 5518 pounds. The total cost of feed and pasture averaged $90.92 per horse.

Pasture

The average length of the pasture season was 158 days. Cows were turned out in the spring on May 17, and were stabled in the fall on October 21.

The average charge for the use of pasture (table 21) was $6.13 per cow in addition to $1.96 per cow for the pasture of meadows, cabbage fields,

TABLE 21. PASTURE CHARGES

	Number of animal units pastured	Charge for pasture	
		Total	Per animal unit
Cows	2,153	$13,134	$ 6.10
Heifers	402.5	3,094	7.69
Herd bulls	36	174	4.83
Horses	171	598	3.50
Colts	2	22	11.00
Meadows pastured after hay was removed	1,537	$2,954	$1.92
Cabbage bait	764	$1,212	$1.59
Peavines pastured	40	$35	$0.88

and pea fields. This makes a total charge to cows, for the use of pasture, of $8.09 per cow, or 13 cents per 100 pounds of milk sold. The charge for pasture per unit of product has remained practically constant in this area for three years. It is 44 per cent higher than that found for Broome County in 1915.

On the 95 farms there were 7405.5 acres devoted to pasture. The returns from milk sold during the pasture season amounted to $117,147; the value of feed used by cows supplementary to pasture was $20,246, thus leaving a surplus of $96,901, which is $1020 per farm, or $13.09 per acre, in addition to returns from the growth of young cattle.

Bedding

An average of 7.7 tons of bedding was used per farm by cattle and horses. The charge for bedding averaged $1.50 per cow, or 2 cents per 100 pounds of milk produced. The kinds, amounts, and charges for bedding used on these farms, are given in table 22:

TABLE 22. BEDDING USED

Kind of bedding	Cows		Heifers		Herd bulls		Horses	
	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:								
Oat straw	203	$1,524	63.4	$486	15.5	$110	67.8	$503
Oat and barley straw	65	448	18.5	135	4	30	19.5	138
Barley straw	37	229	15	96	4.5	37	15.5	104
Buckwheat straw	1	5	2	15	......	......	2	10
Rye straw	......	......	......	......	......	......	1	6
Wheat straw	11	65	12.5	94	1.5	9	12	76
Total home-grown	317	$2,271	111.4	$826	25.5	$186	117.8	$837
Purchased:								
Oat straw	28.3	$261	23.4	$206	0.6	$6	5	$33
Buckwheat straw	5	15	3	9	......	......	2	6
Shavings	50.5	510	10	90	......	......	......	......
Sawdust	18	154	10	100	......	......	......	......
Total purchased	101.8	$940	46.4	$405	0.6	$6	7	$39
Total bedding	418.8	$3,211	157.8	$1,231	26.1	$192	124.8	$876

Labor

The average rate per hour for operator's labor was 33 cents, for hired labor 23 cents, and for all human labor 28 cents. The average rate for horse labor was 17 cents per hour. The rate for human labor on these farms is higher than in the two preceding years. The variations in rates per hour asked by the operators, and in the rates paid for hired labor, are given in table 23.

TABLE 23. VARIATIONS IN RATES PER HOUR FOR OPERATORS AND HIRED MEN

Rate per hour (cents)	Operators		Hired men	
	Number of farms	Per cent	Number of farms	Per cent
13	......	......	1	1.7
14	......	......	1	1.7
15	1	1.1	......	......
16	......	......	3	5.2
17	......	......	2	3.5
18	......	......	5	8.6
19	......	......	2	3.5
20	3	3.2	5	8.6
21	1	1.0	3	5.2
22	1	1.0	4	6.9
23	2	2.1	3	5.2
24	5	5.3	9	15.5
25	2	2.1	2	3.5
26	2	2.1	4	6.9
27	5	5.3	2	3.4
28	1	1.0	2	3.4
29	......	......	1	1.7
30	25	26.3	7	12.1
31	......	......	1	1.7
32	3	3.2	......	......
33	17	17.9	......	......
35	3	3.2	......	......
40	19	20.0	......	......
46	......	......	1	1.7
50	4	4.2	......	......
83	1	1.0	......	......
Total	95	100.0	58	100.0

The charges for the direct human labor on cows averaged $33.41 per cow, or 52 cents per 100 pounds of milk sold. The horse labor in addition to hauling milk was an insignificant item. (Table 24.)

An average of 132 hours per cow, or 2 hours per 100 pounds of milk produced, was required on these farms. The time spent per cow has constantly decreased during the past three years. The first year the average was 152 hours per cow, the second year it was 140 hours, and the third year it was 132 hours. This indicates that the high cost of labor and the relatively low price of milk have resulted in a more economical use of labor. Some of the reduction in labor requirement has resulted from the greater use of trucks in hauling milk, so that less time is required for this. Practically the same amount of labor is expended in milking, but the other labor on cows, chiefly feeding and care, has decreased from 70 hours per cow in 1921 to 56 hours per cow in 1923.

TABLE 24. LABOR REQUIRED IN PASTURE AND WINTER PERIODS

	Hours in pasture period				Hours in winter period				Total hours			
	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value
Human labor for cows:												
Hauling milk	10,573	4.9	0.2	$ 2,895	16,821	7.9	0.2	$ 4,606	27,394	12.8	0.2	$ 7,501
Milking	54,830	25.6	1.0	15,266	80,726	37.7	0.9	22,522	135,556	63.3	1.0	37,788
Other human labor	18,613	8.7	0.3	5,268	100,811	47.0	1.2	28,499	119,424	55.7	0.8	33,767
Total	84,016	39.2	1.5	$23,429	198,358	92.6	2.3	$55,627	282,374	131.8	2.0	$79,056
Total except hauling milk	73,443	34.3	1.3	$20,534	181,537	84.7	2.1	$51,021	254,980	119.0	1.8	$71,555
Horse labor for cows:												
Hauling milk	12,435	5.8	0.2	$2,164	27,025	12.6	0.3	$4,705	39,460	18.4	0.3	$6,869
Other horse labor	123	0.1	0.0	22	1,249	0.6	0.0	226	1,372	0.7	0.0	248
Total	12,558	5.9	0.2	$2,186	28,274	13.2	0.3	$4,931	40,832	19.1	0.3	$7,117
Human labor for heifers	852	.....	.	$244	11,209	....	.....	$3,186	12,061	......	....	$3,430
Horse labor for heifers	......	....	....	....	48	...	....	$9	48	....	....	$9

Hauling milk

The average distance to the milk station was 1.6 miles. Of the total farms delivering milk, 82 hauled their own milk, 11 hired all of their milk hauled, and 2 both hauled and hired. In 1923, 27 per cent of the farms used automobiles or trucks for hauling milk, as against 18 per cent in 1922. The charges for hauling milk amounted to $8.24 per cow, or 13 cents per 100 pounds of milk sold. The data are given in table 25:

TABLE 25. CHARGES FOR HAULING AND DELIVERY TO THE MILK STATION, 136,518 HUNDREDWEIGHT OF MILK

	Pasture period	Winter period	Total
Human labor:			
Number of farms	84	84	....
Hours	10,573	16,821	27,394
Value	$2,895	$4,606	$7,501
Horse labor:			
Number of farms	61	82	....
Hours	12,435	27,025	39,460
Value	$2,164	$4,705	$6,869
Value of total human and horse labor	$5,059	$9,311	$14,370
Hauling hired:			
Number of farms	....	....	13
Cash paid	....	....	$1,196
Use of automobiles and trucks:			
Number of farms	....	....	26
Value	....	....	$2,229
Total charges for hauling milk	....	....	$17,795
Amount received for hauling milk	....	....	$136
Total net cost of hauling milk	....	....	$17,659
Net cost, per 100 pounds, of hauling milk	....	....	$0.13

Use of buildings

The average charge for the use of buildings was $5.62 per cow, or 9 cents per 100 pounds of milk. The data are given in table 26:

TABLE 26. CHARGES FOR USE OF BUILDINGS

Value of barns and other buildings used for dairy cattle	$202,675
Interest at 5 per cent	$10,133
Taxes	3,978
Insurance	1,031
Total	$15,142
Charged to:	
Cows	$12,027
Heifers	2,573
Herd bulls	542
Total	$15,142

Use of equipment

The charge for use of equipment was $2.34 per cow, or 4 cents per 100 pounds of milk sold.

Interest

The interest charge on cows averaged $6.67 per cow, or 10 cents per 100 pounds of milk sold.

Depreciation on cows

The average value of grade cows was $80 per head, and of purebred cows $162; the average for both grade and purebred cows was $111. The depreciation was $13.30 per cow net, or 21 cents per 100 pounds of milk sold. The average decrease in the value of grade cows as used on the records was $4 per head, and of purebred cows $15 per head The depreciation in 1922 was $4.94 per head, or 8 cents per 100 pounds of milk sold, and that in 1921 was $2.70 per cow, or 5 cents per 100 pounds of milk sold. The average of the farmers' estimates as to the decreased value of cows during the year of study was $13 each, for grades and for purebreds. Altho it has been an established practice in all previous records to omit as a credit any appreciation resulting from an increase in the market value of cows, and any depreciation resulting from a decrease in their market value, the depreciation, especially on purebreds, has been so great during the past three years that it was very difficult for dairymen to keep this principle in mind when placing values on their cows. In consequence, for the year under report there has been included in depreciation on cows, as nearly as can be determined from the records, some decrease because of changes in their market value. If this were omitted, the cost of producing milk would be lowered a few cents per 100 pounds, and the loss per 100 pounds of milk would be lowered accordingly.

The number of cows that were sold, that were eaten on farms, and that died, was 27.7 for each 100 cows. Of the cows replaced, 51 per cent were raised at home and 49 per cent were purchased.

Bull service

The average cost of keeping 91 herd bulls was $126 per cattle unit, or $5.10 per cow kept. There was a depreciation on bulls of $30 per cattle unit. The charge for bull service was 8 cents per 100 pounds of milk sold. The data are given in table 27:

TABLE 27. COST OF BULL SERVICE

	Total		Per cattle unit	
	Amount	Value	Amount	Value
Costs:				
Concentrates	693 cwt.	$1,396	811 lbs.	$16.33
Succulent feed	163.8 tons	868	3,832 lbs.	10.15
Dry forage	176.1 tons	2,485	4,119 lbs.	29.06
Whole milk	13,222 lbs.	286	155 lbs.	3.34
Skimmilk	912 lbs.	3	11 lbs.	0.04
Pasture	....	174	....	2.04

TABLE 27 (*concluded*)

	Total		Per cattle unit	
	Amount	Value	Amount	Value
Costs (*continued*):				
Bedding	26 1 tons	$ 192	611 lbs.	$ 2.25
Interest		708		8.28
Depreciation		2,600		30.41
Use of buildings		542		6.34
All other costs		2,508		29.33
Total		$11,762		$137.57
Returns:				
Manure	636 tons	$884	7 4 tons	$10.34
Service		72		0.84
Total		$956		$11.18
Cost of keeping own herd bulls		$10,806		$126.39
Service hired		$113		
Net cost of bull service		$10,919		
Net cost per cow		$5.10		
Number of herd bulls	91.3			
Cattle units of herd bulls	85.5			

Miscellaneous charges

The miscellaneous expenses for producing milk are given in table 28. These averaged $4.53 per cow, or 7 cents per 100 pounds of milk sold.

TABLE 28. MISCELLANEOUS EXPENSES FOR COWS

Item	Charge
Advertising	$ 25
Salt	863
Grinding feed	322
Insurance	1,254
Dairymen's League News	80
Transfers	16
Coal, oil, gasoline	1,434
Farm share of upkeep and operation of automobile	539
Ice, and sawdust for ice	348
Cow tester, acid, etc	914
Spray materials	256
Telephone	321
Veterinary, medicines, etc	1,859
Electricity	1,069
Water	15
Stamps and stationery	21
Any other expenses	376
Total	$9,712
Total per cow	$4.53
Total per 100 pounds of milk sold wholesale	$0.07

RETURNS

Milk and milk products

The returns from milk sold are given in tables 12 and 13, pages 13 and 14. Data for milk and its products used on the farm are given in table 29:

TABLE 29. RETURNS FROM MILK PRODUCTS SOLD AND MILK AND ITS PRODUCTS USED ON THE FARM

	Number of farms	Number of pounds of product	Total value
Milk sold retail	3	13,405	$461
Milk used:			
Operators' families	95	327,502	$6,575
Hired men's families	18	37,234	736
Landlords' families	3	7,540	158
Poultry	1	119	2
Total milk used	95	372,395	$7,471
Milk products used:			
Butter, family use	1	153	70
Total milk and its products used, except that fed to cattle	95	372,548	$7,541
Milk fed:			
Heifers	72	365,405	$7,871
Veals	9	29,533	609
Bull calves to be sold	5	14,702	310
Bull calves to be raised	16	13,222	286
Total milk fed to cattle	73	422,862	$9,076
Milk products fed:			
Skimmilk:			
Heifers	1	3,648	$11
Bull calves to be raised	1	912	3
Total milk products fed to cattle	1	4,560	$14
Total milk and its products fed to cattle	73	427,422	$9,090
Equivalent, in pounds of milk, of milk and its products used	95	799,970	......
Pounds of fat in milk retailed and in milk and its products used	......	27,323	......

The average amount of milk used by operators' families was 3447 pounds per family. Of the total milk produced, 6 per cent was used on the farm. The average production per cow was 6753 pounds, containing 227 pounds of butterfat. The production was 569 pounds more per cow on this group of farms than on the group in the same area in 1921.

The production per cow in the stabling period averaged 4070 pounds, or 19.6 pounds per cow per day. In the pasture period the production was 2683 pounds, or 17 pounds per cow per day. The winter production was 1.8 pounds higher per cow per day than in 1921, and the pasture-period production was 1.2 pounds higher per cow per day.

Calves born during the year

Of a total of 2082 calves born during the year, 118, or 5.7 per cent, were born dead (table 30). Of the cows on hand at the end of the year, 1 per

TABLE 30. NUMBER OF CALVES BORN DURING THE YEAR, AND THEIR VALUE AT BIRTH

	Number of farms	Number of calves	Per cent	Value	Value of each at birth
Heifers to be raised or sold:					
Purebred	35	192	9 8	$3,670	$19.11
Grade	43	155	7.9	515	3.32
Bulls to be kept:					
Purebred	11	12	0.6	178	14.83
Grade	5	6	0.3	19	3.17
Bulls sold or to be sold:					
Purebred	8	33	1.7	730	22.12
Calves vealed or to be vealed	94	1,551	79.0	4,338	2.80
Calves deaconed	7	15	0.7	......	......
Deacon hides	6	(14)	......	12	0.86
Total calves born alive *	95	1,964	100.0	$9,462	$4.82
Live calves per 100 cows	......	92	......	......	......
Calves born dead	35	118	......	......	......
Dead calf hides	1	(3)	......	4	......
Total credited to cows	......	......	......	$9,466	......
Cows that would not breed	17	22	......	......	......
Cows with unsound quarters	70	138	......	......	......

*The total number of calves exceeds the number of cows calving, by two, because of twins.

cent would not breed and 6.5 per cent had unsound quarters. The average weight of cows was 1017 pounds. The average number of weeks during which cows were dry was 8. The value at birth of grade heifers was $3.32 each; of purebred heifers, $19.11; of calves for vealing, $2.80; and of all live calves born during the year, $4.82. Of the total live calves born during the year, 17.7 per cent were heifers raised, and 79.7 per cent were vealed or deaconed. The proportion of calves vealed has constantly increased in the past three years.

The returns from calves sold amounted to $4.42 per cow, or 7 cents per 100 pounds of milk sold.

Manure

The average value of manure was $1.39 per ton at the barnyard. In 1922 it was $1.84, and in 1921 it was $1.97, per ton. The amount recovered

from cows averaged 7.6 tons per cow, valued at $10.58 per cow, or 17 cents per 100 pounds of milk. The data are given in table 31:

TABLE 31. MANURE RECOVERED FROM CATTLE AND HORSES

	All stock	Cows	Heifers	Herd bulls	Bull calves to be sold	Veals	Horses
Manure recovered (tons)	23,423	16,297	3,618	636	62	16	2,794
Value at $1.39 per ton at the barnyard.....	$32,558	$22,654	$5,031	$884	$86	$23	$3,880

Miscellaneous returns

The various miscellaneous items credited to cows averaged 39 cents per cow, or 1 cent per 100 pounds of milk sold.

SUMMARY OF COSTS AND RETURNS

The costs and returns for cows, expressed per cow and per 100 pounds of milk sold wholesale, are given in table 32. The net cow cost of producing milk was $2.44 per 100 pounds, and the herd cost was $2.58, or 14 cents higher, per 100 pounds. The cost per pound of butterfat was 73 cents.

With concentrates at $41.66, silage at $5.29, and dry forage at $14.36, per ton, and labor at 28 cents per hour, the average loss was $20.25 per cow, or 32 cents per 100 pounds of milk sold.

The returns from cows, per hour of labor, above all other costs in the production of milk on these farms, was 12.6 cents.

TABLE 32. SUMMARY OF COSTS AND RETURNS, 2142 COWS

	Per cow	Per 100 pounds of milk sold wholesale
Costs:		
Concentrates..	$43.83	$0.69
Succulent feed..	21.89	0.34
Dry forage..	24.51	0.39
Pasture..	8.09	0.13
Bedding..	1.50	0.02
Human labor..	33.41	0.52
Horse labor..	0.12	....
Hauling milk..	8.24	0.13
Use of buildings..	5.62	0.09
Use of equipment..	2.34	0.04
Interest on cows..	6.67	0.10
Depreciation on cows..	13.30	0.21
Bull service..	5.10	0.08
Miscellaneous..	4.53	0.07
Total costs..	$179.15	$2.81

TABLE 32 (*concluded*)

	Per cow	Per 100 pounds of milk sold wholesale
Returns:		
Milk sold wholesale:		
Cash	$130.87	$2.05
Certificates of indebtedness	4.67	0.07
Milk retailed	0.21	....
Milk and milk products used, except that fed to cattle	3.52	0.05
Milk and milk products fed to cattle	4.24	0.07
Calves and calf hides	4.42	0.07
Manure	10.58	0.17
Miscellaneous	0.39	0.01
Total returns	$158 90	$2.49
Loss	$20.25	$0.32
Cow cost of producing milk	$155 79	$2.44
Herd cost of producing milk	......	$2.58
Cow cost per pound of butterfat	......	$0.73

The variations in the cost of producing milk are shown in table 33:

TABLE 33. Variations in Cost of Producing Milk on 95 Farms

Per cent of cows freshening from September to December, inclusive	Number of farms with cow cost per 100 pounds of milk sold wholesale as designated				
	Less than $2.50	$2.50 to $3.00	$3.01 to $4.00	$4.01 to $4.50	More than $4.50
Less than 25 per cent	7	2	7	......	1
From 25 to 50 per cent	17	9	7	......	......
More than 50 per cent	24	12	8	1	......
All herds	48	23	22	1	1

COST OF RAISING HEIFERS

The average cost of raising heifers to two years of age is shown in table 34. This cost was $106.64 per cattle unit.

The average age at which heifers freshened the first time was 26.5 months. The number freshening, the average age, and the value of the heifers, are given in table 35.

The average value of heifers at the time of first freshening was $64.58 for grades, $126.77 for purebreds, and $98.22 for all of the 318 heifers. The average value of all heifers was $22 less than in the preceding year.

TABLE 34. Cost of Raising Heifers

	All herds			Per cent of cows freshening from September to December, inclusive					
	Total		Amount per cattle unit	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Amount	Value		Amount*	Value	Amount*	Value	Amount*	Value
Costs:									
Whole milk	365,405 pounds	$ 7,871	782 pounds	27,963	$ 530	161,595	$3,401	175,847	$3,940
Skimmilk, farm	3,648 pounds	11	8 pounds	...	...	...	...	3,648	11
Grain	6,198 cwt.	12,456	1,326 pounds	677	1,414	2,724	5,410	2,797	5,632
Silage	1,113 tons	5,887	4,764 pounds	133	703	401	2,122	579	3,062
Other succulent feed	22.5 tons	55	96 pounds	...	...	20.5	45	2	10
Hay	880.8 tons	12,975	3,770 pounds	118	1,795	357.3	5,286	405.5	5,894
Other dry forage	4 tons	25	17 pounds	0.5	6	3	15	0.5	4
Pasture	...	3,094	...	...	346	...	1,152	...	1,596
Bedding	157.8 tons	1,231	675 pounds	13	98	88	696	56.8	437
Human labor	12,061 hours	3,430	26 hours	1,370	385	6,352	1,838	4,339	1,207
Horse labor	48 hours	9	...	...	...	...	...	48	9
Use of buildings	...	2,573	...	...	263	...	1,069	...	1,241
Use of equipment	...	809	...	...	70	...	263	...	476
Interest on stock	...	3,684	...	...	182	...	1,538	...	1,964
Miscellaneous	...	490	...	...	8	...	206	...	276
Total costs	...	$54,600	...	...	$5,800	...	$23,041	...	$25,759
Returns:									
Manure	3,618 tons	$ 5,031	7.7 tons	351	$ 489	1,498	$ 2,083	1,769	$ 2,459
Appreciation	...	29,720	...	...	2,134	...	15,678	...	11,908
Total returns	...	$34,751	...	...	$2,623	...	$17,761	...	$14,367
Difference (loss)	...	$19,849	...	...	$3,177	...	$5,280	...	$11,392
Value at birth, plus purchases, less sales and hides and those eaten	...	$263	...	...	$178	...	$2,732	...	-$2,647
Cost of raising a heifer to two years of age:									
Total	...	$49,832	...	...	$5,489	...	$23,690	...	$20,653
Per cattle unit	...	$106.64	...	...	$109.78	...	$122.43	...	$92 28
Number of cattle units	467.3	...	...	50 0	...	193 5	...	223 8	...

* The same unit of quantity is used in this column as is used in the first column for amounts.

TABLE 35. AGE OF HEIFERS FRESHENING FOR THE FIRST TIME, AND THEIR VALUE

Age (months)	Number of heifers	Value
19	2	$ 180
21	2	150
22	5	375
23	6	420
24	70	6,088
25	39	4,405
26	34	2,800
27	59	6,505
28	58	6,355
29	1	100
30	31	2,910
33	1	100
34	6	425
36	4	420
Total	318	$31,233

FALL OR SPRING FRESHENING

The usual sorting was made according to the proportion of cows freshening from September to December, inclusive. An average of 50.9 per cent of the cows freshened during this period, as against 45.7 per cent in the preceding year and 40.8 per cent in the year 1921. This indicates the tendency to shift toward winter dairying, which is characteristic in many of the intensive milk-producing regions of the State. When such a shifting is made, the lactation period of cows is extended and the average test of the milk is slightly lowered. A difference of 0.1 per cent between herds that tend toward summer production and herds that tend toward winter production is common.[4]

TABLE 36. COWS FRESHENING BY MONTHS

	All herds		Per cent of cows freshening from September to December, inclusive					
			Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1923:								
May	95	4.6	23	7.7	56	7.4	16	1.6
June	52	2.5	18	6.0	27	3.5	7	0.7
July	27	1.3	11	3.7	14	1.8	2	0.2
August	94	4.5	18	6.0	35	4.6	41	4.0
September	280	13.5	6	2.0	87	11.4	187	18.4
October	304	14.6	11	3.7	85	11.2	208	20.4
November	307	14.7	18	6.0	78	10.2	211	20.7
December	168	8.1	6	2.0	48	6.3	114	11.2
1924:								
January	128	6.2	14	4.6	60	7.9	54	5.3
February	137	6.6	42	14.0	55	7.2	40	3.9
March	242	11.6	69	23.0	101	13.3	72	7.1
April	246	11.8	64	21.3	116	15.2	66	6.5
Total	2,080	100.0	300	100.0	762	100.0	1,018	100.0

[4] See Bulletin 409 of this experiment station, page 438; Bulletin 441, page 42; and Bulletin 452, page 38.

Apparently the fat test of milk in the dairy regions is not decreasing any faster than would result from causing cows to give more milk by shifting to a more intensive winter system; that is, less than 0.1 per cent in five years.[5] So much emphasis, however, is placed upon this point by milk companies, that often the dairy farmer gets the idea that the fat test of milk is decreasing very rapidly.

The number of cows freshening by months is given in table 36.

There is the same relationship of labor income to winter dairying this year as in the preceding year, as shown in table 37. The winter dairies have consistently made higher labor incomes.

TABLE 37. RELATION OF SEASON OF FRESHENING TO VARIOUS FACTORS

	Per cent of cows freshening from September to December, inclusive			All herds
	Less than 25 per cent	From 25 to 50 per cent	More than 50 per cent	
Number of farms	17	33	45	95
Number of cows	332	822	988	2,142
Cows per farm	19.5	24.9	22.0	22.5
Average capital per farm	$12,289	$16,916	$15,772	$15,546
Average labor income per farm	+$66	+$275	+$581	+$383
Pounds of milk produced per farm	104,546	168,222	158,590	152,265
Pounds of milk produced per cow	5,353	6,753	7,223	6,753
Weight of cows (pounds)	953	1,012	1,043	1,017
Per cent of milk sold from November to April	39.8	49.9	57.8	52.5
Butterfat test of milk (per cent)	3.4	3.3	3.4	3.4
Per cent of cows freshening from September to December, inclusive	13.7	39.1	70.7	50.9
Cost of milk per 100 pounds	$2.64	$2.44	$2.40	$2.44
Price received per 100 pounds	$2.18	$2.13	$2.11	$2.12

The ages of cows on hand at the end of the year are shown in table 38. The large percentage of young cows in the herd is apparent.

TABLE 38. AGES OF 2134 COWS ON HAND APRIL 30, 1924

Age (years)	Per cent of cows freshening from September to December, inclusive						All herds	
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
2–3	44	13.3	155	18.7	160	16.4	359	16.8
3–4	38	11.4	115	13.9	173	17.8	326	15.3
4–5	42	12.7	156	18.8	161	16.5	359	16.8
5–6	54	16.3	162	19.6	173	17.8	389	18.2
6–7	50	15.1	87	10.5	129	13.3	266	12.5
7–8	35	10.5	69	8.3	81	8.3	185	8.7
8–9	35	10.5	42	5.1	45	4.6	122	5.7
9–10	13	3.9	19	2.3	37	3.8	69	3.2
Over 10	21	6.3	23	2.8	15	1.5	59	2.8
Total	332	100.0	828	100.0	974	100.0	2,134	100.0

[5] Farm Economics (Cornell University), no. 31, page 393.

Variations in the labor incomes on the 95 farms are shown in table 39. Of the total, 24 made labor incomes of more than $1000 in 1923, and 33, or about one-third, failed to make interest.

TABLE 39. VARIATIONS IN LABOR INCOMES ON 95 FARMS

Per cent of cows freshening from September to December, inclusive	Number of farms making labor incomes as designated				
	Minus $500 or more	Minus $499 to 0	Plus $1 to plus $500	Plus $500 to $1000	More than $1000
Less than 25 per cent	4	5	4	1	3
From 25 to 50 per cent	6	8	7	4	8
More than 50 per cent	5	5	8	14	13
All herds	15	18	19	19	24

The average return per hour of labor after all other costs were met was 9.9 cents per hour in summer dairies and 12.7 cents per hour in winter dairies (table 40).

TABLE 40. COSTS AND RETURNS FOR THE THREE SEASONAL GROUPS

	Per cent of cows freshening from September to December, inclusive					
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale
Costs:						
Concentrates	$33.05	$0.65	$44.83	$0.71	$46.62	$0.68
Succulent feed	15.90	0.31	20.53	0.32	25.04	0.37
Dry forage	24.17	0.48	22.90	0.36	25.97	0.38
Pasture	6.54	0.13	8.45	0.13	8.31	0.12
Bedding	1.01	0.02	1.91	0.03	1.32	0.02
Human labor	32.59	0.64	35.25	0.56	32.14	0.47
Horse labor	..	....	0.02	....	0.24	....
Hauling milk	8.72	0.17	7.63	0.12	8.59	0.13
Use of buildings	5.93	0.12	5.18	0.08	5.87	0.09
Use of equipment	1.59	0.03	2.09	0.03	2.80	0.04
Interest on cows	5.00	0.10	6.88	0.11	7.07	0.10
Depreciation on cows	9.10	0.18	12.91	0.20	15.04	0.22
Bull service	3.48	0.07	6.28	0.10	4.66	0.07
Miscellaneous	3.74	0.07	4.88	0.08	4.52	0.07
Total costs	$150.82	$2.97	$179.74	$2.83	$188.19	$2.76
Returns:						
Milk sold wholesale:						
Cash	$106.51	$2.10	$130.99	$2.06	$138.95	$2.04
Certificates of indebtedness	3.90	0.08	4.40	0.07	5.15	0.07
Milk retailed	....	....	0.52	0.01	0.04	....
Milk and milk products used, except that fed to cattle	3.10	0.06	3.21	0.05	3.91	0.06
Milk and milk products fed to cattle	2.25	0.05	4.77	0.08	4.48	0.06
Calves and calf hides	1.86	0.03	5.21	0.08	4.62	0.07
Manure	9.50	0.19	10.57	0.16	10.94	0.16
Miscellaneous	0.12	....	0.58	0.01	0.32	0.01
Total returns	$127.24	$2.51	$160.25	$2.52	$168.41	$2.47
Loss	$23.58	$0.46	$19.49	$0.31	$19.78	$0.29
Returns per hour of human labor above all other costs	....	$0.099	....	$0.135	....	$0.127

FERTILITY MAINTENANCE

The uses of fertilizer and lime are summarized in tables 41 and 42:

TABLE 41. SUMMARY OF FERTILIZER AND LIME USED ON 95 FARMS

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
For corn for grain:					
2-8-10	2	1	300	....	$6
Total fertilizer	2	1	300	300	$6
For corn for the silo:					
Acid phosphate	7	76	22,750	....	$199
0-12-5	1	2	1,000	....	13
1-8-4	3	12	4,350	....	69
2-8-2	4	22	6,500	....	108
2-8-3	1	10	3,500	....	56
2-8-4	1	12	4,000	....	66
2-8-6	2	11	3,000	....	53
2-8-7	2	12	3,600	....	61
2-8-10	16	112.5	29,630	....	519
2-10-2	1	6	4,000	....	64
2-12-2	1	14	4,000	....	76
2-12-3	1	17	3,400	....	63
3-8-3	1	7	2,000	....	37
3-9-5	1	14	4,000	....	72
4-8-4	5	51	12,501	....	215
4-8-6	1	8.5	500	....	7
4-8-7	3	24	7,200	....	129
4-8-10	1	10	4,000	....	80
4-8-16	1	2	600	....	13
4-10-6	1	7	3,500	....	53
Kinds not found	1	8	1,600	....	25
Total fertilizer	47	438	125,631	287	$1,978
Ground limestone	2	23	37,000	1,609	$93
For sweet corn:					
2-8-10	1	1	300	....	$6
Total fertilizer	1	1	300	300	$6
For oats:					
Acid phosphate	11	119.5	28,475	....	$301
0-10-8	1	10	2,000	....	30
1-8-4	2	14	3,500	....	62
2-8-2	2	21	3,500	....	70
2-8-6	1	6	1,000	....	18
2-8-7	1	7	2,100	....	32
2-8-10	8	72.5	15,500	....	262
4-8-2	1	5	625	....	13
4-8-4	3	22	5,066	....	95
4-8-10	1	19	5,700	....	114
4-10-6	1	6	1,800	....	27
Kinds not found	1	10	1,400	....	21
Total fertilizer	30	312	70,666	226	$1,045

TABLE 41 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
For oats (*continued*):					
Quicklime	1	15	4,000	267	$24
Hydrated lime	2	9	3,200	356	$32
Ground limestone	25	244.8	405,850	1,658	$942
For oats and barley:					
Acid phosphate	2	21	4,600	....	$41
2-8-10	1	5	800	....	13
4-8-7	1	7	3,000	....	51
Total fertilizer	3	33	8,400	255	$105
Ground limestone	2	12.8	18,850	1,473	$48
For oats and peas:					
1-8-4	1	5	1,500	....	$26
4-8-7	1	3	500	....	10
Total fertilizer	2	8	2,000	250	$36
Ground limestone	3	8	16,600	2,075	$35
For oats, peas, and barley:					
Ground limestone	1	5.5	12,000	2,182	$23
For barley:					
Acid phosphate	2	38	5,500	....	$49
0-10-8	1	6	1,500	....	20
1-8-4	1	5	1,500	....	28
2-8-10	1	15	2,000	....	40
4-10-6	1	21	6,300	....	95
Total fertilizer	5	85	16,800	198	$232
Ground limestone	3	40	34,630	866	$98
For buckwheat:					
Acid phosphate	1	3	400	....	$ 4
4-12-8	1	6	600	....	13
Total fertilizer	2	9	1,000	111	$17
For wheat:					
Acid phosphate	1	4	450	....	$ 4
2-8-10	2	8	4,750	....	75
Total fertilizer	3	12	5,200	433	$79
For millet:					
2-8-10	1	1	200	....	$4
Total fertilizer	1	1	200	200	$4
For sudan grass:					
2-8-10	1	1	200	....	$4
Total fertilizer	1	1	200	200	$4

TABLE 41 (*continued*)

Forms of

Fertilizer:
Sodium nitra
Acid phospha
0–10–8......
0–12–5......
1–8–4.......
2–8–2.......
2–8–3.......
2–8–4.......
2–8–6.......
2–8–7.......
2–8–10.....
2–10–2....
2–12–2....
2–12–3.....
3–8–3......
3–9–5......
4–8–2......
4–8–4......
4–8–5.....
4–8–6.....
4–8–7.....
4–8–10.....
4–8–16.....
4–9–7.....
4–10–6.....
4–12–4....
4–12–8....
5–8–7......
5–10–5........
6–8–10.......
Kinds not
Total fertili

Forms of lime:
Quicklime....
Hydrated lim
Ground limest
Total lime..

r and	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
....	1	1.5	500	...	$6
....	1	1.5	500	333	$6
....	9	19.0	54,200	2,853	$155
....	6	44.5	92,875	2,087	$211
....	3	34.0	20,725	610	$57
....	8	15.7	9,800	....	$101
....	1	0.5	150	....	2
....	2	2	1,000	....	18
....	3	1.5	1,563	...	25
....	1	0.8	700	....	10
....	18	26	17,658	. .	329
....	1	1	800	....	13
....	1	1.5	1,000	....	21
....	2	2.5	1,800	....	36
....	2	2.5	1,875	....	28
....	4	5.3	3,130	....	55
....	3	13	9,200	....	130
....	1	1.5	800	...	18
....	1	1	600	....	11
....	1	1	1,000	....	18
....	1	8	500	...	10
....	1	2.5	2,000	...	38
....	48	86.3	53,576	621	$863
....	1	0.5	200	400	$1
....	1	1	2,000	2,000	$6
....	1	4	400	....	$ 13
....	13	40.2	26,623	....	215
....	2	4	2,100	....	37
....	3	11	6,250	....	99
....	3	7.5	7,834	....	129
....	1	3	4,000	....	70
....	2	4	2,700	....	47
....	13	33.5	14,010	....	253
....	1	1.5	1,000	....	14
....	1	5.5	3,600	....	66
....	2	6	4,400	....	89
....	1	3.5	500	....	6
....	1	1.2	600	....	12
....	5	19	11,000	....	198
....	1	1.3	300	....	6
....	1	3	2,600	....	57
....	1	10	2,000	....	35
....	1	16	19,200	....	288
....	1	10	5,400	....	97

Acid phosp
purchased.
20 per cent of
was ground li
Of the man
for cabbage,
23.2 per cent
was used for
utilization of
ency to spre

TABLE 41 (*concluded*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
For cabbage (*continued*):					
4-12-8	1	10	3,000	....	$ 68
5-8-7	1	2.5	1,000	....	17
5-10-5	2	13	5,500	....	110
Kinds not found	1	1.5	1,000	....	10
Total fertilizer	50	211.2	125,017	592	$1,936
Ground limestone	15	62.5	110,500	1,768	$261
For market peas:					
Acid phosphate	9	76	22,332	....	$206
1-8-4	2	5.5	2,100	....	38
2-8-4	3	51	24,300	....	436
2-8-7	1	0.8	300	....	4
2-8-10	13	36.5	12,592	....	223
2-12-2	2	4.2	2,200	....	46
2-12-3	1	7	2,000	....	37
4-8-2	1	1.5	375	....	8
4-8-4	2	7	1,733	....	33
4-8-10	1	2	2,000	....	38
4-10-6	1	10.5	8,700	....	131
4-12-8	1	3	900	....	20
Total fertilizer	34	205	79,532	388	$1,220
Ground limestone	6	24.5	44,250	1,806	$115
For beans:					
1-8-4	1	0.5	225	....	$3
Total fertilizer	1	0.5	225	450	$3
For beets:					
4-8-4	1	0.5	200	....	$4
Total fertilizer	1	0.5	200	400	$4
Ground limestone	1	0.5	500	1,000	$1
For turnips:					
2-8-4	1	0.5	200	....	$4
Total fertilizer	1	0.5	200	400	$4
For pumpkins:					
2-8-10	1	1	300	....	$6
Total fertilizer	1	1	300	300	$6
For cucumbers:					
4-12-8	1	0.2	300	....	$7
Total fertilizer	1	0.2	300	1,500	$7
For pasture:					
Ground limestone	1	4	8,000	2,000	$21

TABLE 42. TOTAL FERTILIZER AND LIME USED

Forms of fertilizer and lime	Pounds used	Per cent of total pounds	Value	Average price per ton
Fertilizer:				
Sodium nitrate	400	0.1	$ 13	$65.00
Acid phosphate	121,430	24.8	1,126	18.55
0–10–8	3,500	0.7	50	28.57
0–12–5	1,000	0.2	13	26.00
1–8–4	15,425	3.2	265	34.36
2–8–2	17,250	3.5	295	34.20
2–8–3	3,500	0.7	56	32.00
2–8–4	37,897	7.7	660	34.83
2–8–6	8,000	1.6	141	35.25
2–8–7	9,400	1.9	154	32.77
2–8–10	98,240	20.0	1,740	35.42
2–10–2	4,000	0.8	64	32.00
2–12–2	8,000	1.6	149	37.25
2–12–3	9,000	1.9	166	36.89
3–8–3	2,000	0.4	37	37.00
3–9–5	4,000	0.8	72	36.00
4–8–2	2,000	0.4	42	42.00
4–8–4	25,700	5.3	472	36.73
4–8–5	500	0.1	6	24.00
4–8–6	2,975	0.6	47	31.60
4–8–7	24,830	5.1	443	35.68
4–8–10	21,200	4.3	368	34.72
4–8–16	4,000	0.8	88	44.00
4–9–7	2,000	0.4	35	35.00
4–10–6	39,500	8.1	594	30.08
4–12–4	6,000	1.2	108	36.00
4–12–8	4,800	1.0	108	45.00
5–8–7	2,000	0.4	35	35.00
5–10–5	6,000	1.2	120	40.00
6–8–10	2,000	0.4	38	38.00
Kinds not found	4,000	0.8	56	28.00
Total fertilizer	490,547	100.0	$7,561	$30.83
Forms of lime:				
Quicklime	4,000	0.5	$ 24	$12.00
Hydrated lime	3,400	0.4	33	19.41
Ground limestone	857,980	99.1	2,066	4.82
Total lime	865,380	100.0	$2,123	4.91

Acid phosphate represents nearly one-fourth of the commercial fertilizer purchased. The kind used in next largest amount was 2–8–10, representing 20 per cent of the total pounds of fertilizer purchased. Most of the lime was ground limestone, costing an average of $4.82 per ton.

Of the manure, 31.7 per cent was used for corn for the silo, 9.5 per cent for cabbage, 0.7 per cent for potatoes, 31.3 per cent for new seeding, and 23.2 per cent for old meadows (table 43). The remaining 3.6 per cent was used for miscellaneous crops. There is very little shifting in the utilization of manure, with the exception that there appears to be a tendency to spread the manure thinner. The average rate of application

was 10.7 tons per acre. There was more manure recovered per acre of crop land in 1922 and 1923 than in 1921, and the average rate of spreading was less in these two years.

TABLE 43. USE OF MANURE ON 95 FARMS

Crop	Number of farms using	Acres manured	Tons applied	Tons per acre manured	Per cent of tons applied
Corn for grain	4	7	76	10.9	0.3
Corn for the silo	76	536	7,386	13.8	31 7
Sweet corn	1	0.5	10	20 0	0 0
Oats	7	28	246	8.8	1.1
Barley	1	3	30	10.0	0 1
Wheat	2	7	49	7.0	0.2
Hay, first year	75	677 6	7,305	10 8	31 3
Hay, old meadows	53	694	5,397	7 8	23 2
Cabbage	47	161.8	2,208	13 6	9.5
Potatoes	11	14 3	164	11.5	0.7
Peas	11	35.3	342	9 7	1.5
Garden	2	2	24	12.0	0.1
Pasture	3	10	61	6.1	0 3
Total	......	2,176.5	23,298	10.7	100.0
Not used	......	......	125	......	....

LABOR DISTRIBUTION

Of the total labor, 59.7 per cent was spent on cattle, 3.8 per cent on other livestock, 22.9 per cent on cultivated crops, 3.8 per cent on grain and annual hay crops, 7.2 per cent on hay, and 2.6 per cent on other crops and for miscellaneous labor.

The productive work units averaged 238 per man and 63 per work animal; there were 2.2 men and 3.6 work animals per farm. The acres of crops per man averaged 26.7 and per work animal 16.5.

SUMMARY OF AVERAGES

The averages of the farms studied for the crop year 1923 are given in table 44:

TABLE 44. SUMMARY FOR COMPARING INDIVIDUAL FARMS WITH THE AVERAGES FOR 95 FARMS

	Average for 95 farms	Individual farms
Year of record, ending April 30	1924	....
County	Chenango	....
Labor income	+$383	....
Labor income if pool prices had been received	+$336	....
Size of business:		
1. Productive man-work units	529	....
2. Acres of crops	59.2	....
3. Acres pastured (woods in equivalent of open pasture)	78.0	....
4. Number of cows, average	23	....
5. Number of men, including operator	2.22	....

TABLE 44 (*continued*)

	Average for 95 farms	Individual farms
Size of business (*concluded*):		
6. Capital	$15,546	.....
7. Hundredweight of milk sold per farm	1,438	.....
8. Animal units per farm.		
Including work animals	33.3	.....
Excluding work animals	29.7	.....
Type of business:		
9. Average miles to milk station	1.6	.....
10. Per cent of total productive man-work units on:		
Cattle	59.7	.....
Cultivated crops	22.9	.....
Grain crops	3.8	.....
Hay	7.2	.....
All else	6.4	.....
11. Total productive man-work units on farm per acre of crops	8.9	.....
12. Per cent of capital in:		
Real estate	67	.....
Livestock	25	.....
Equipment and supplies	8	.....
13. Per cent of cows freshening from September to December, inclusive	50.9	.....
14. Per cent of milk sold during:		
May, June, July	27.3	.....
August, September, October	20.2	.....
November, December, January	25.9	.....
February, March, April	26.6	.....
15. Average weight of cows (pounds)	1,017	.....
16. Average weeks cows are dry	8.0	.....
17. Per cent of cows less than four years old	32.1	.....
18. Per cent of cows replaced	27.7	.....
19. Per cent of cows added that were raised at home	51.5	.....
20. Per cent of cows added that were purchased	48.5	.....
21. Average age of heifers when freshening for first time (months)	26.5	.....
22. Grade of milk	Grade B	.....
23. Per cent of milk produced which is sold	94.5	.....
24. Per cent of milk kept at farm	5.5	.....
Balance of business:		
25. Pasture acres per animal unit pastured	2.7	.....
26. Acres of crops per animal unit	1.8	.....
27. Manure per acre of crops (tons)	4.2	.....
28. Manure applied per acre of crops receiving manure (tons)	10.7	.....
29. Value of purchased fertilizer per acre of crops	$1.34	.....
30. Labor distribution (good, fair, poor)	Good	.....
31. Important sources of income, and receipts from each, per farm:		
Milk	$3,061	.....
Appreciation on cattle*	$106	.....
Crops sold	$1,027	.....
32.†		
33.†		
34. Per cent of receipts from crops	19.6	.....

* Includes value of calves born during the year.
† The data for these items are not computed for this study, but the numbers are included here in order to facilitate comparison with corresponding tables in other publications of this series.

TABLE 44 (*continued*)

	Average for 95 farms	Individual farms
Rates of production:		
35. Crop index, all crops (based on average yields for New York State)	134 8	....
36. Crop index:		
Corn for the silo	190.2	.....
Oats (threshed)	112.6	....
Hay	125 5	......
37. Pounds of milk produced per cow	6,753	....
38. Pounds of milk sold per cow	6,380	....
39. Pounds of milk produced per dollar invested in cows	61	....
40. Value of milk and its products sold per cow	$136	....
41. Appreciation on cattle per cattle unit	$3.77	......
Labor efficiency:		
42. Productive man-work units per man	238	....
43. Acres of crops per man	26.7	.....
44. Animal units, except work animals, per man	13 4	....
45. Productive horse-work units per work animal	63	......
46. Acres of crops per work animal	16.5	..
47. Labor returns per man	$558	.....
48. Labor returns per man-work unit	$2.34	...
49. Per cent of farms using milking machines	59	..
50. Per cent of months machines are used	85	.....
51. Hundredweight of milk produced per man	686	.....
Human labor:		
Hours per cow per year:		
52. Milking	63	....
53. Hauling milk	13	......
54. Other labor	56	....
Hours per 100 pounds of milk produced:		
55. Pasture season	1.5	....
56. Winter	2.3	....
57. For year	2.0	....
Capital efficiency:		
58.†		
59.†		
60.†		
61.†		
62.†		
63.†		
64.†		
65.†		
66. Value of machinery and equipment per acre of crops	$19.39	....
Feeding efficiency:		
Feed:		
Per cow per year:		
67. Concentrates (pounds)	2,047	....
68. Silage (pounds)	7,434	....
69. Other succulent feed (pounds)	873	....
70. Dry forage (pounds)	3,421	....
71.†		
72.†		
73. Days of pasture	158	....

† The data for these items are not computed for this study, but the numbers are included here in order to facilitate comparison with corresponding tables in other publications of this series.

TABLE 44 (*concluded*)

	Average for 95 farms	Individual farms
Feeding efficiency (*concluded*):		
Feed (*concluded*):		
Per cow per day during winter:		
74. Concentrates (pounds)	8.1	..
75. Silage (pounds)	34.7	...
76. Other succulent feed (pounds)	2.4	.....
77. Dry forage (pounds)	16.1	...
78.†		
79.†		
80.†		
Per 100 pounds of milk produced in pasture period:		
81. Days of pasture	5.9	
82. Concentrates (pounds)	13.2	....
83. Silage and other succulent feed (pounds)	22.1	.....
84. Dry forage (pounds)	2.8	.....
Per 100 pounds of milk produced in winter period:		
85. Concentrates (pounds)	41.6	....
86. Silage (pounds)	177.4	......
87. Other succulent feed (pounds)	12.2	....
88. Dry forage (pounds)	82 2	.....
89.†		
90.†		
Per 100 pounds of milk produced thru the year:		
91. Concentrates (pounds)	30.3	.....
92. Silage (pounds)	110.1	.....
93. Other succulent feed (pounds)	12.9	....
94. Dry forage (pounds)	50.7	......
95.†		
96.†		
Costs and returns for cows:		
97. Total costs per cow	$179	....
98. Returns, exclusive of milk sold wholesale	$23	....
99. Cost of milk sold per cow	$156	....
100. Value of milk sold, cash per cow	$131	....
101. Certificates of indebtedness, per cow	$5	....
102. Gain or loss per cow (loss)	$20	....
103. Price received per 100 pounds of milk	$2.12	....
104. Cost of producing 100 pounds of milk	$2.44	....
105. Loss per 100 pounds of milk	$0.32	....
Cost of raising a heifer:		
106. To two years of age	$107	....
107. To age of freshening (approximate)	$116	....

† The data for these items are not computed for this study, but the numbers are included here in order to facilitate comparison with corresponding tables in other publications of this series.

The important business factors for each farm for the crop year 1923 are given in table 45.

TABLE 45. Important Business Factors for 95 Dairy Farms with Cash Crops and Mixed Hay Roughage

(Arranged according to size of farm operated)

Farm no.	Acres operated	Acres of crops	Number of cows	Average total capital	Man equivalent	Milk sales	Crop sales	Current farm expense	Labor income	Labor income on pool-price basis	Cow cost of milk per hundredweight	Pounds of milk produced per cow
380	43	20 3	12 5	$ 6,756	1.4	$1,718	$ 351	$1,391	$ 388	$ 388	$2 71	6,808
397	58	24 1	16 5	14,076	2.2	2,527	2,293	4,117	1,400	1,050	2 12	7,516
417	63	27 2	20.0	9,206	1.5	3,464	270	3,186	834	373	2.53	7,401
541	65	25 0	12.5	12,130	2 0	1,023	194	1,608	− 480	− 480	3.50	4,331
543	73	31.5	11 0	10,771	1.3	1,449	49	1,810	− 287	− 287	3 19	7,598
430	75	27 0	11 0	9,545	1 9	2,381	461	1,811	523	486	2.21	10,264
433	84	41.8	13 5	14,043	1 8	1,511	358	1,402	202	202	3 17	5,022
395	85	49 0	20 5	13,933	1 4	2,667	10	2,228	− 45	− 45	2.46	6,756
539	88	30.0	12 5	8,202	1.3	1,725	401	1,839	522	522	2.15	6,679
545	88	48.0	16 5	5,000	1 4	2,240	403	1,776	828	828	1 74	6,236
394	91	32 5	12.5	9,612	1.6	1,302	449	1,838	− 628	− 643	3 08	5,409
393	93	46 8	17 0	15,434	2.0	2,562	458	3,626	546	546	3 54	7,762
540	93	49 0	24 0	19,634	2.2	3,347	1,531	6,002	− 509	− 509	3.65	7,376
406	94	69.0	12 0	8,120	2 6	1,327	11,758	9,725	4,159	4,159	4 14	5,246
454	96	40.5	12 5	10,033	1 0	1,570	. .	1,068	− 269	− 269	3 36	5,896
362	100	58.5	12 0	8,124	1 8	1,432	974	1,723	421	421	3 02	6,272
371	100	51 5	12 0	11,462	2 1	1,818	860	2,604	− 46	− 46	2 31	7,627
376	100	42 7	20 0	9,442	1.9	3,915	....	4,460	917	917	1.75	9,526
410	100	21 0	12 0	8,954	1 1	1,595	.. ..	942	102	− 117	3 04	5,728
460	100	39 0	19 5	14,400	1 5	3,142	777	2,415	1,513	1,513	1.42	8,016
367	102	45 3	21.5	11,058	2 5	2,563	700	3,003	391	391	2 14	6,097
434	104	31 0	13.0	5,172	1 0	996	85	663	423	423	3.14	3,883
449	105	51 5	18 0	14,798	2 7	2,736	520	3,806	689	632	2.50	7,484
536	106	19 0	20.5	10,662	1.3	2,049	327	1,879	− 68	− 88	2.03	5,299
386	108	35 0	15.0	11,968	1 3	2,179	719	1,974	560	560	2 26	7,335
440	108	34 0	14 5	8,170	1 4	2,389	563	1,604	725	725	2 57	7,818
372	110	44 0	18 5	12,454	1 1	3,146	599	2,416	242	242	2.18	8,472
381	110	31.0	14 5	10,985	2 0	2,168	......	2,596	− 1,294	− 1,294	3.41	7,868
399	110	34 0	12.0	9,398	3.1	1,285	294	2,447	− 835	− 835	3.17	5,272

TABLE 45 (*concluded*)

Farm no.	Acres operated	Acres of crops	Number of cows	Average total capital	Man equivalent	Milk sales	Crop sales	Current farm expense	Labor income	Labor income on pool-price basis	Cow cost of milk per hundredweight	Pounds of milk produced per cow
429	110	46.0	20.0	$17,168	2.1	$3,001	$1,520	$ 2,797	$ 479	$ 479	$2.33	$ 7,799
443	110	40.6	17.5	7,425	2.2	1,673	907	3,256	79	79	3.28	5,129
446	112	45.0	36.0	25,760	3.2	5,125	75	8,115	− 2,621	− 2,621	2.68	7,544
388	116	40.3	13.5	8,960	2.4	1,794	1,100	2,848	− 45	− 45	2.78	7,115
447	116	40.1	27.0	19,588	2.5	2,964	1,405	3,709	931	931	2.29	5,531
441	120	33.0	15.5	8,870	2.0	2,042	832	2,147	1,135	1,135	1.64	6,504
403	125	60.2	20.0	13,322	2.0	704	1,519	2,765	− 1,652	− 1,652	7.76	1,965
442	125	49.8	23.5	21,290	2.2	3,301	1,450	4,550	1,563	1,563	2.05	7,538
451	125	60.5	16.0	17,268	1.7	2,242	687	4,158	1,097	1,097	2.38	7,081
455	125	63.3	18.0	15,160	4.0	1,823	316	2,981	14	14	3.00	5,203
408	126	62.0	16.0	17,522	1.6	1,321	624	1,519	455	455	2.62	4,669
427	128	64.0	24.5	12,496	2.7	3,154	225	2,952	− 305	− 305	2.69	6,540
423	130	66.5	30.5	21,249	2.0	5,202	159	3,352	957	165	2.70	7,258
534	130	36.5	11.5	6,134	1.1	1,782	299	1,268	475	475	2.42	7,458
537	130	51.0	29.0	16,449	2.5	4,690	715	7,796	786	786	2.14	8,370
535	132	55.8	19.5	15,558	2.4	2,588	1,073	2,656	1,492	1,492	2.26	6,756
432	133	39.8	23.5	12,730	2.7	2,545	750	3,829	− 73	− 405	2.85	4,502
401	135	51.5	22.0	19,236	2.0	2,810	488	1,959	1,662	1,662	2.01	6,042
544	135	45.5	18.0	7,396	1.4	2,631	90	1,681	1,102	1,102	2.21	7,495
425	140	58.5	22.0	12,891	2.0	3,548	632	2,531	1,526	1,056	1.78	7,140
392	147	56.4	16.5	8,826	2.1	2,983	1,353	3,531	1,267	839	2.12	7,202
415	147	42.7	16.5	7,962	1.3	1,700	50	1,890	934	934	2.55	5,309
365	150	63.5	18.5	12,186	2.0	2,620	560	1,848	751	751	2.09	7,014
368	150	62.5	30.5	14,204	2.6	4,076	450	5,229	− 1,686	− 1,686	2.47	6,596
379	150	83.0	37.0	18,094	3.0	5,182	275	5,008	201	201	2.69	6,739
411	150	27.0	23.0	11,417	1.1	1,873	182	1,580	− 537	− 537	3.15	4,588
419	153	58.0	21.0	23,045	1.2	2,546	1,234	4,207	280	280	2.63	6,514
387	160	54.0	22.5	15,401	2.3	3,366	3,560	4,989	1,665	1,665	2.24	7,387
402	160	64.0	27.0	16,806	2.2	3,398	1,587	3,682	1,123	1,123	2.70	6,201
538	160	57.0	31.5	13,626	2.4	4,642	36	4,308	479	479	1.87	6,933

461	163	65.7	16.0	14,902	2.6	2,505	3,764	4,023	1,931	1,931	2.04	7,219
390	165	52.8	27.5	39,363	1.8	3,806	396	5,265	− 247	− 247	3.71	7,385
444	165	67.8	36.0	17,555	2.5	5,303	630	4,583	2,591	1,831	2.49	6,441
383	173	72.5	33.5	19,535	3.0	7,035	1,170	6,208	677	677	1.96	10,680
407	174	86.5	30.5	12,388	2.1	5,039	2,383	4,133	2,267	2,267	2.16	7,830
405	180	79.0	24.0	22,395	2.0	2,996	3,635	3,848	1,076	1,076	3.43	6,022
366	182	50.0	35.5	17,036	3.0	4,649	...	4,973	− 1,404	− 1,404	2.30	6,102
391	190	76.6	29.5	16,662	2.4	3,034	965	3,468	− 376	− 376	2.29	5,142
412	190	55.0	20.5	14,112	1.6	1,881	540	2,133	− 61	− 61	2.02	4,828
375	193	53.0	20.5	16,602	2.2	2,658	633	2,635	− 1,097	− 1,097	3.36	6,911
459	195	60.0	18.0	16,744	2.5	2,293	408	4,130	− 1,450	− 1,450	3.25	6,927
378	197	88.0	23.5	18,166	2.3	4,465	982	4,303	− 53	− 53	2.02	9,873
431	197	64.0	24.0	9,452	2.5	2,520	325	3,596	− 1,284	− 1,284	3.02	5,483
439	204	50.8	26.5	17,724	2.2	3,026	30	4,000	− 1,558	− 1,558	3.09	6,052
377	210	57.0	24.5	14,196	3.1	4,409	667	5,158	838	838	1.78	9,287
428	219	65.5	23.0	14,704	3.1	3,877	2,286	4,475	865	572	1.84	7,598
453	221	71.0	34.0	18,482	2.2	4,388	304	3,089	1,028	1,028	1.24	6,472
409	234	93.2	32.0	34,940	3.9	5,066	2,668	8,182	403	403	2.68	7,817
542	239	70.2	16.0	7,417	1.1	1,904	54	1,750	679	679	3.08	6,016
364	240	50.3	21.5	10,630	1.2	2,718	262	1,697	1,305	1,305	1.52	6,233
437	240	74.8	27.0	21,758	1.7	2,583	212	2,469	− 447	− 447	2.60	5,065
546	244	58.0	41.5	20,329	4.3	4,160	650	4,818	− 159	− 159	2.24	5,270
448	246	125.5	46.5	41,904	4.2	6,246	1,834	8,164	1,496	1,496	2.30	7,053
547	250	79.5	20.0	12,496	1.5	2,944	1,286	2,376	1,632	1,488	1.92	7,597
398	257	92.0	20.0	17,066	1.9	2,469	957	2,169	696	696	2.51	6,348
373	260	74.0	33.5	20,237	2.0	5,856	...	4,198	− 39	− 39	2.61	8,502
436	260	106.0	31.0	31,323	2.9	4,481	1,990	6,484	− 927	− 927	2.71	7,288
374	268	141.5	13.0	9,519	2.6	1,658	1,056	2,897	− 331	− 331	2.59	6,555
435	270	50.0	32.0	15,562	3.2	4,053	78	4,472	384	384	1.59	6,717
416	275	125.0	26.5	19,682	2.1	3,585	1,742	3,144	1,852	1,779	2.15	6,447
413	300	122.0	31.5	21,396	2.8	4,391	2,000	4,930	99	99	2.11	6,600
549	300	73.2	25.0	13,189	2.7	2,895	615	3,161	278	278	2.66	5,829
384	314	151.0	32.0	30,794	4.0	5,135	6,112	7,246	1,829	1,829	2.62	7,991
533	370	97.0	37.0	36,323	3.2	7,914	5,282	12,345	2,405	2,405	2.77	10,193
548	450	125.0	46.5	16,742	2.9	3,882	70	4,315	− 321	− 321	2.26	4,279
400	550	124.0	47.5	43,973	3.7	4,948	2,004	9,263	− 2,675	− 2,675	3.08	6,118

The labor income, crop sales, production per cow, and price received for milk, for each farm when the farms are arranged from the lowest to the highest cost of producing milk, are shown in table 46:

TABLE 46. COST OF PRODUCING MILK, PRICES RECEIVED, AND LABOR INCOMES, ON DAIRY FARMS IN A CASH-CROP REGION WITH MIXED HAY ROUGHAGE, FOR THE CROP YEAR 1923

(Arranged according to cost of milk)

Farm no.	Cost of milk per 100 pounds	Labor income	Labor income on pool-price basis	Pounds of milk produced per cow	Average price received for milk (certificates of indebtedness plus cash)	Crop sales
453	$1.24	$1,028	$1,028	6,472	$2.05	$ 304
460	1.42	1,513	1,513	8,016	2.12	777
364	1.52	1,305	1,305	6,233	2.16	262
435	1.59	384	384	6,717	1.95	78
441	1.64	1,135	1,135	6,504	2.09	832
545	1.74	828	828	6,236	2.23	403
376	1.75	917	917	9,526	2.13	......
377	1.78	838	838	9,287	2.05	667
425	1.78	1,526	1,056	7,140	2.38	632
428	1.84	865	572	7,598	2.27	2,286
538	1.87	479	479	6,933	2.17	36
547	1.92	1,632	1,488	7,597	2.05	1,286
383	1.96	677	677	10,680	1.99	1,170
401	2.01	1,662	1,662	6,042	2.17	488
378	2.02	− 53	− 53	9,873	1.97	982
412	2.02	− 61	− 61	4,828	2.00	540
536	2.03	− 68	− 88	5,299	2.00	327
461	2.04	1,931	1,931	7,219	2.21	3,764
442	2.05	1,563	1,563	7,538	2.03	1,450
365	2.09	751	751	7,014	2.15	560
379	2.09	201	201	6,739	2.14	275
413	2.11	99	99	6,600	2.15	2,000
392	2.12	1,267	839	7,202	2.55	1,353
397	2.12	1,400	1,050	7,516	2.38	2,293
367	2.14	391	391	6,097	2.08	700
537	2.14	786	786	8,370	2.06	715
416	2.15	1,852	1,779	6,447	2.19	1,742
539	2.15	522	522	6,679	2.15	401
407	2.16	2,267	2,267	7,830	2.15	2,383
372	2.18	242	242	8,472	2.10	599
430	2.21	523	486	10,264	2.14	461
544	2.21	1,102	1,102	7,495	2.06	90
387	2.24	1,665	1,665	7,387	2.12	3,560
546	2.24	− 159	− 159	5,270	1.97	650
386	2.26	560	560	7,335	2.14	719
535	2.26	1,492	1,492	6,756	2.09	1,073
548	2.26	− 321	− 321	4,279	2.11	70
391	2.29	− 376	− 376	5,142	2.06	965
447	2.29	931	931	5,531	2.12	1,405
366	2.30	− 1,404	− 1,404	6,102	2.17	....
448	2.30	1,496	1,496	7,053	2.08	1,834
371	2.31	− 46	− 46	7,627	2.11	860
429	2.33	479	479	7,790	2.24	1,520
451	2.38	1,097	1,097	7,081	2.09	687
534	2.42	475	475	7,458	2.10	299

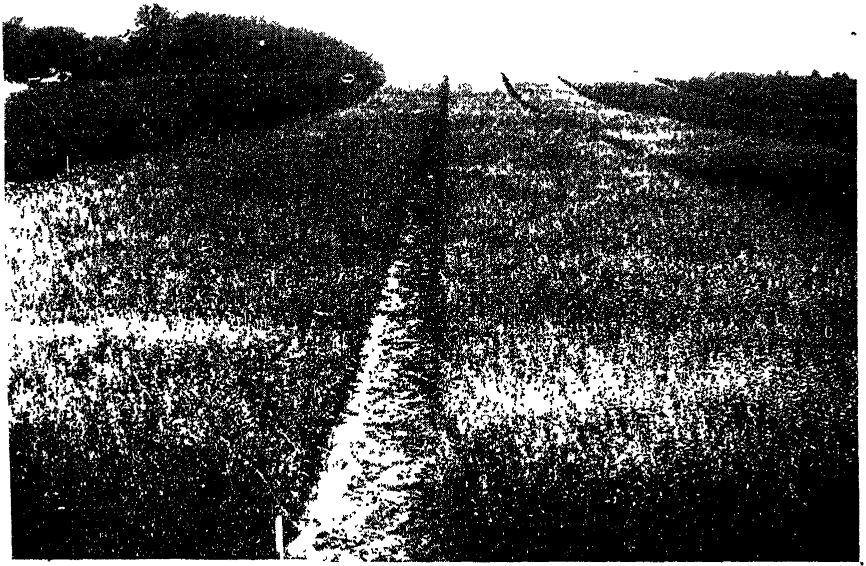
TABLE 46 (*concluded*)

Farm no.	Cost of milk per 100 pounds	Labor income	Labor income on pool-price basis	Pounds of milk produced per cow	Average price received for milk (certificates of indebtedness plus cash)	Crop sales
395	$2.46	$ - 45	$ - 45	6,756	$2 00	$ 10
368	2.47	- 1,686	- 1,686	6,596	2.07	450
444	2.49	2,591	1,831	6,441	2.42	630
449	2 50	689	632	7,484	2.13	520
398	2.51	696	696	6,348	2.11	957
417	2.53	834	373	7,401	2.43	270
415	2.55	934	934	5,309	2.12	50
440	2.57	725	725	7,818	2.19	563
374	2 59	- 331	- 331	6,555	2.10	1,056
437	2 60	- 447	- 447	5,065	1.99	212
373	2.61	- 39	- 39	8,502	2.13	....
384	2 62	1,829	1,829	7,991	2 16	6,112
408	2.62	455	455	4,669	2.13	624
419	2 63	280	280	6,514	2.13	1,234
549	2 66	278	278	5,829	2 04	615
409	2 68	403	403	7,817	2.12	2,668
446	2.68	- 2,621	- 2,621	7,544	2.13	75
427	2.69	- 305	- 305	6,540	2.12	225
402	2.70	1,123	1,123	6,201	2.08	1,587
423	2.70	957	165	7,258	2 40	159
380	2.71	388	388	6,808	2 09	351
436	2.71	- 927	- 927	7,288	2.05	1,990
533	2 77	2,405	2,405	10,193	2.20	5,282
388	2.78	- 45	- 45	7,115	2.10	1,100
432	2.85	- 73	- 405	4,502	2 46	750
455	3.00	14	14	5,203	2.12	316
362	3 02	421	421	6,272	2.14	974
431	3 02	- 1,284	- 1,284	5,483	1.99	325
410	3.04	102	- 117	5,728	2.43	....
394	3 08	- 628	- 643	5,409	2.08	449
400	3.08	- 2,675	- 2,675	6,118	2 09	2,004
542	3.08	679	679	6,016	2.09	54
439	3 09	- 1,558	- 1,558	6,052	2.07	30
434	3 14	423	423	3,883	2.07	85
411	3 15	- 537	- 537	4,588	2 13	182
399	3.17	- 835	- 835	5,272	2 10	294
433	3.17	202	202	5,022	2.41	358
543	3.19	- 287	- 287	7,598	2.01	49
459	3.25	- 1,450	- 1,450	6,907	2.13	408
443	3.28	79	79	5,129	2.10	907
375	3.36	- 1,097	- 1,097	6,911	1.95	633
454	3 36	- 269	- 269	5,896	2.18	....
381	3.41	- 1,294	- 1,294	7,868	2.02	....
405	3.43	1,076	1,076	6,022	2.14	3,635
541	3.50	- 480	- 480	4,331	2.14	194
393	3.54	546	546	7,762	2 09	458
540	3.65	- 509	- 509	7,376	2.12	1,531
390	3.71	- 247	- 247	7,385	2.02	396
406	4.14	4,159	4,159	5,246	2.34	11,758
403	7 76	- 1,652	- 1,652	1,965	2.00	1,519

January, 1925 Bulletin 436

Results of Experiments with Oats in New York

H. H. Love and W. T. Craig
In cooperation with the Office of Cereal Investigations, Bureau of Plant Industry, United States Department of Agriculture



GENERAL VIEW OF THE OAT PLATS ON THE EXPERIMENT STATION FIELD

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RESULTS OF EXPERIMENTS WITH OATS IN NEW YORK[1]

H. H. Love and W. T. Craig

Oats constitute one of the most important field crops of New York. Although, as a rule, they are not a profitable crop, yet, because of their value in feeding, they will continue to be grown as one of the leading small-grain crops. Then, too, since they fit into many systems of crop rotation and make a good nurse crop for seeding, there will always be a large acreage sown to oats.

Since oats do form one of the most widely grown and useful field crops of the State, it is important to increase the yield per acre if this can be done without a great increase in cost of production. Better cultural methods, and the use of seed of only those types that will give a maximum yield, may accomplish this result. In order to determine what types will give the greatest yield and whether the yield can be improved by breeding, the Department of Plant Breeding at Cornell University, in cooperation with the Office of Cereal Investigations of the United States Department of Agriculture, has been conducting experiments along this line since 1908.

The results of the earlier experiments were reported in Bulletin 343 of the Cornell University Agricultural Experiment Station. It is the purpose of the present bulletin to give the results obtained from 1914 to and including 1922, with a report on the more important strains tested to and including 1924. It will not be possible to give all the data regarding all the results, but those of the most importance are presented. The experiments reported here have to do mainly with the comparison of many sorts as to yield and other qualities.

MATERIAL USED

The sorts under comparison were of two kinds, commercial varieties and strains. By " commercial varieties " is meant the kinds that are on the market and may be purchased from seedsmen or others. These may be introductions from other countries, or varieties produced through the efforts of breeders in different parts of the United States. By " strains " is meant the different sorts that have been developed as a result of the oat-improvement work conducted at Ithaca.

Many hundred selections have been made from different varieties and from various fields throughout the State. A great many different hybrids have also been made, and selections from these have been tested as to their yielding capacity. These selections are given numbers by which they are known until they have proved to be of value or have been discarded as worthless. If they prove to be better than ordinary oats and worth recommending, they are then given a name.

METHODS OF TESTING

Whether selections have been made from varieties or from fields, the plan for sowing is to sow in rows from three to five feet long, depending

[1] Paper No. 137, Department of Plant Breeding, Cornell University, Ithaca, New York.

on the amount of seed available. The seed is not spaced, but is drilled in evenly by hand. Check rows are sown every tenth row, at the same rate as the selections. This rate, of course, also varies according to the amount of seed available. The seed for the check rows is chosen from the best strain or variety that has been obtained, as determined from its behavior over a period of years. The best strain or variety is used because its yield and other qualities are known and comparisons may be made directly in the field between the new lines under test and the check variety. Selection from the head rows is based largely upon appearance in comparison with the check. In making the selections, attention is given to such characters as stiff straw, type, maturity, freedom from disease, and the like. Later the grain is examined for color, quality, and other characters that may make a strain desirable. The yield of these short rows is not taken, since it is obvious that the results of such a test would give no very definite information as to the yielding ability of these strains.

After the various studies have been made, the selections are designated for continuing the work another season. In all cases it is planned, wherever possible, to obtain enough seed to sow at least two rod rows. The two rows of each sort are not sown adjacent, but the practice is to sow a single row from each strain continued in the test, and then, when the entire series is sown, to repeat the process without changing the order of the varieties. In arranging the plan of planting for this second year and for succeeding years, the different strains are grouped together in accordance with their morphological characters. Where the time of maturity has been shown to be different, the early, mid-season, and late strains are grouped, so that there will not be any competition effect due to early and late strains growing side by side. In this second-year test, a check is sown every fifth row. During the growing season the agronomic notes which are usually considered necessary are taken. The kinds of notes will depend, of course, upon what is under observation for the particular crop.

The yields from the second-year test are determined; and, while it is realized that such yields are not so reliable as those made from a larger number of tests, selections may be made on the yield basis by comparing them with the check yields and being rather liberal in selecting those types that show up fairly well in comparison with the checks. Any strain that is considerably below the check yields is eliminated at once. Those that are superior or about equal to the check are continued for further testing. It is recognized that by this method a good sort may occasionally be discarded early in the test. At the same time it is believed to be much better to eliminate in this way, making it possible to bring in new selections much more frequently, and thereby in a few years to deal with much larger numbers than would be possible if all the selections which had been made were tested for a longer period of years.

The strains that have shown promise in the second-year test are continued for the third year and placed in a five rod-row test. These rows are handled the same as in the second-year test; that is, a check row is sown every fifth row, and a single row of each strain is sown until all of the sorts are used once, and then the entire series is repeated four times. The field work, the technique of comparisons, and other practices, are, of course, much the same as in the second-year test.

The strains that are unusually promising from the five-row series are immediately placed in a ten-row series the following year. Those that are of doubtful value are kept in the five-row series, and those that are apparently of little value are discarded at once. In the ten rod-row series, each sort is used ten times, with a check every fifth row, and the series is repeated as described for the previous tests.

When a new selection has proved its value in the ten rod-row series and seems to give promise of taking its place in commercial growing, it is placed in what is termed an "advanced test." The advanced test is arranged in the following manner: Three rod rows of each strain are sown in adjacent rows and each strain tested is replicated nine times, thus giving ten blocks of three rows each. In arranging this series, three rows of the check variety are first sown, then three rows of variety A, three rows of variety B, and three rows of the check. This plan is continued until each strain is included, then the series is replicated. Thus each strain under test grows next to a check. The advantage of this method is that it gives a somewhat better measure as to stiffness of straw and some general characters than does the series where each variety is used in a single row. At the same time, since every strain is growing next to a check and the check has proved qualities, it is comparatively easy to draw conclusions regarding the behavior of the new strain.

The method of obtaining yields from the advanced test is to thresh each row separately and weigh the grain separately. By this method, if it is felt that competition plays a part, the results from the middle rows only may be used for the yield determination. There will be little effect resulting from competition, however, since the strains included in tests conducted by investigators interested in improvement are likely to be similar so far as their general growth and behavior are concerned. Competition has not been shown to have any effect in these experiments.

In the advanced test, in addition to the new strains, the better commercial varieties or the varieties that the farmers are likely to be growing are included, in order to make a direct comparison between these and the new selections.

DRILL PLATS

From the advanced test, the promising strains, as well as some of the better commercial varieties, are selected for growing in drill plats. The drill that is now used in sowing these drill plats is an eleven-hoe drill with the two outside hoes closed, so that nine furrows are sown for each strain. The drill plats are 100 feet long. This length is used because all the land operated by the Department of Plant Breeding is laid off in tiers 100 feet in width. By closing the outside hoes and allowing the wheel to follow the wheel track in drilling the next plat, plenty of space is left between plats to allow for the binder at harvest time, so that the possibility of mechanical mixture is largely eliminated. The drill plats are always sown in duplicate, or, if land is available, in triplicate. It is desirable to have them replicated even more. A check plat is sown as every fifth plat, but if land is available it is more desirable to sow it as every third plat. Little dependence is placed upon the yields of these plats, particularly if they are sown only in duplicate, since with most types of soil accurate yields cannot be determined in this way. The plats are used mainly for the multiplication of seed and to permit a com-

parison of the various sorts under field conditions. The new strains that have proved of sufficient value to be distributed for commercial growing are multiplied in multiplication plats, which are carefully rogued to insure seed of a high degree of purity.

The plan used for the rod rows and the advanced test is shown in figure 1.

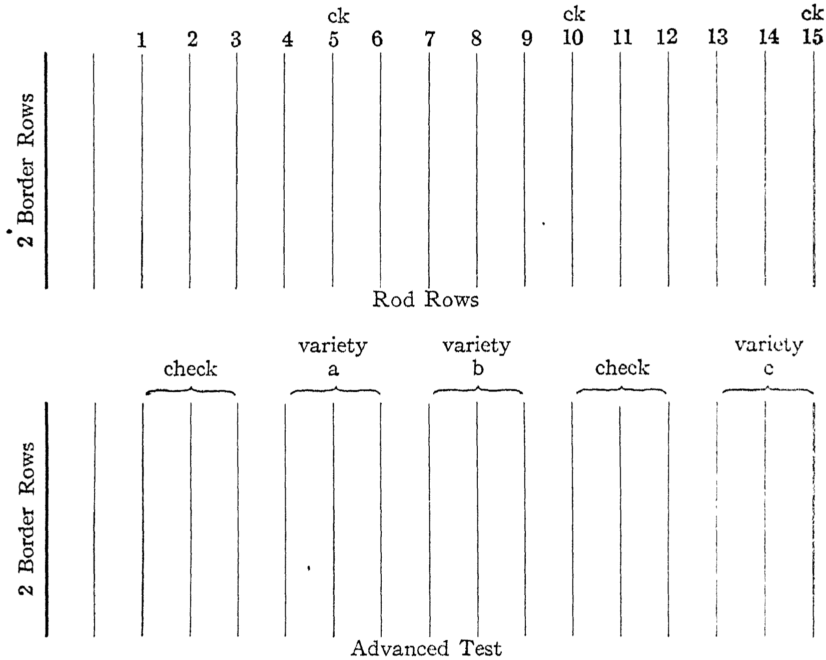

FIGURE 1. PLAN FOR SOWING THE ROD ROWS AND THE ADVANCED TEST

The storage shed, and the grain ready for threshing, are shown in figures 2 and 3.

FIGURE 2. STORAGE SHED USED FOR STORING AND THRESHING GRAIN

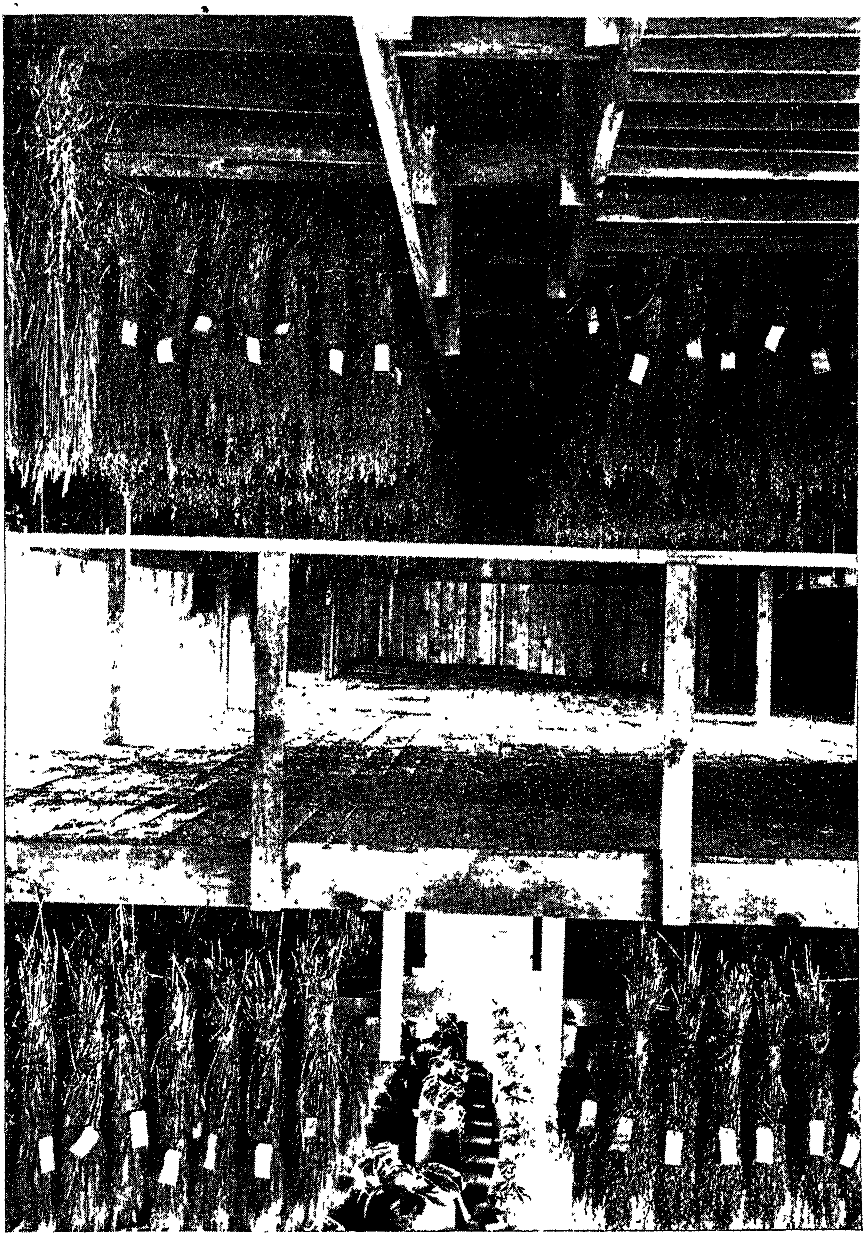

FIGURE 3. INTERIOR VIEW OF STORAGE SHED, SHOWING BUNDLES OF GRAIN AND BAGS OF THRESHED GRAIN

The different series through which a strain is carried may be summed up in the following manner:

First year — Selection from variety or field, tested in three- to five-foot rows, check every tenth row.

Second year.— Rod rows duplicated, check every fifth.

Third year — Rod rows replicated four times, check every fifth.

Fourth and following years — Rod rows replicated nine times, check every fifth.

Advanced test — Rod rows three in a block, replicated nine times, check every third block.

Drill plats — Replicated as many times as land permits, check every fifth or oftener.

Increase plats — For multiplication of seed.

SOIL

For the most part, the experiments at Ithaca were conducted on clay loam soil. It was planned to have the growth conditions represent as nearly as possible the average for the oat-growing sections, and this soil is not heavily fertilized. The chief consideration was to have the soil as uniform as possible for the various tests. The oat crop is planted in regular rotation, following one or two cultivated crops.

RESULTS OF FIELD TESTS, 1914 TO 1922

The results of the tests to determine the yielding power of the many commercial varieties and strains are given in table 1.

These results cover the years from 1914 to 1922, inclusive, but not all of the strains under test during that period are reported here. These strains, as stated above, are the results of individual selections and so it is apparent that many selections would be made which, because of poor yield or other undesirable characters, would be worthless and hence discarded from the experiments after having been under test for a short while. From the years 1914 to 1922 there were more than four thousand selections under test, while only forty-two are reported in the table. Practically all of the commercial varieties that were tested are included because it is possible that some growers will be interested to see how a certain variety compares with others under uniform conditions. Many of these varieties were not under observation for the entire period, as they were discarded when it became apparent that they were not outstanding in yield. A large number of commercial varieties were brought into the tests in 1913 and 1914, and most of these were carried through until 1918, when a number of them were dropped. At the end of 1919 and 1920 more were discarded, so that only a few remained throughout the entire period. Certain standard varieties, as Silvermine and Swedish Select, are carried along as a direct means of comparing the worth of new productions.

The table gives the yield for each year in bushels per acre, and the gain or loss as compared with the check variety. This means that for each year every sort was compared with a check. Each year all check plats were sown to the same sort, and these plats occurred very frequently in the tests, so that any variety under test may be compared directly with this check. When comparing the merits of two sorts as, for example,

TABLE 1. YIELDS, GAIN OR LOSS AS COMPARED WITH THE CHECK, AND ODDS, FOR THE DIFFERENT VARIETIES AND STRAINS UNDER TEST FROM 1914 TO 1922, INCLUSIVE

Variety	1914		1915		1916		1917		1918		1919		1920		1921		1922		Average		Odds
	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	
State Sel. 133-46													57.3	8.2	56.8	13.4	59.7	10.0	57.9	10.5	102:1
Cornellian			77.2	1.9	53.5	8.3	66.1	14.8	65.8	10.9	52.4	10.0	57.3	9.1	63.9	14.1	61.4	12.7	62.2	10.2	>9,999:1
National Sel. 127-9									67.8	8.5	51.6	9.0	48.2	1.6	55.0	4.1	53.1	3.4	55.1	5.3	87:1
O. A. C. No. 72									60.6	10.7	47.6	2.9	51.0	2.1	48.8	1.5	56.3	4.5	52.9	4.3	32:1
President Sel. 129-64											49.0	5.9	52.0	4.5	52.2	4.1	54.9	2.7	52.0	4.3	322:1
Swedish Crown							60.6	14.6	64.4	10.6	49.2	3.4	50.1	0.9	53.6	2.0	47.5	-6.1	54.2	4.2	7:1
Early Pearl			83.4	9.6	35.1	11.5	51.7	-2.0	75.2	10.3	42.8	-2.8	49.3	0.2	51.1	2.6			55.5	4.2	16:1
Irish Victor			74.7	2.4	44.9	0.8	50.4	1.3	58.0	8.1	49.8	5.3	54.4	7.6					55.4	4.2	85:1
President Sel. 129-44									54.6	3.0	54.4	6.6	48.4	2.0	58.1	8.7	47.4	-0.6	52.6	3.9	23:1
Great Northern Sel. 130-8									64.8	10.4	46.2	3.7	49.3	1.5	48.8	-1.2	52.3	4.3	52.3	3.7	14:1
Siberian White (Minn. 202)			80.0	8.4			50.6	1.5	48.6	-1.8	47.0	3.1	53.6	6.5					56.0	3.5	14:1
National Sel. 127-3									65.0	7.1	47.0	3.1	46.8	0.3					52.9	3.5	8:1
Jefferson County Banner													54.5	6.9	53.2	5.1	50.9	-1.7	52.9	3.4	5:1
President Sel. 129-65											47.0	3.6	52.1	4.4	50.2	1.9			49.8	3.3	42:1
Johnson			74.7	0.2	52.0	6.6	50.5	1.6	53.8	4.4									57.7	3.2	17:1
Isbell's New Johnson	49.6	2.7	79.9	4.4	50.1	5.3	49.8	4.2	66.8	7.1	41.0	-2.2	48.1	-0.4					55.0	3.0	39:1
Great Northern Sel. 130-30									62.8	8.7	43.6	0.7	47.7	-0.3					51.4	3.0	4:1
White Maine Oats									69.8	6.7	44.8	0.2	51.1	1.8	50.6	3.2			54.1	3.0	16:1
National Sel. 127-4									63.4	4.8	48.0	3.8	46.6	0.3					52.7	3.0	11:1
Great Northern Sel. 130-31									65.4	11.6	43.6	0.2	45.1	-3.0					51.4	2.9	2:1
National Sel. 127-1											49.2	5.9	46.6	-0.2	46.5	2.7			47.4	2.8	7:1
President Sel. 129-54									55.6	4.0	51.0	3.1	47.2	0.7					51.3	2.6	16:1
Golden Rustproof			79.0	2.8	48.7	0.9	49.6	1.5	57.4	7.4	46.8	1.7	50.7	4.1	46.5	-2.0			54.1	2.3	23:1
National Sel. 127-28											49.0	6.7	45.6	-0.9	44.9	1.2			46.5	2.3	4:1
Gold Mine	48.2	3.5	81.0	4.5	51.6	3.3	53.2	5.7	59.0	4.0	42.6	-3.7	48.0	-0.8	47.2	1.2	53.8	2.3	53.8	2.2	36:1
National Sel. 128-37									61.4	4.1	45.6	1.3	47.9	1.1					51.6	2.2	12:1
Twentieth Century	48.7	1.0	80.5	6.3	42.6	-0.3	48.5	3.0	63.2	7.3	46.0	0.3	47.8	-3.1	46.0	2.2			52.9	2.1	14:1
National Sel. 127-5											48.2	5.2	47.6	0.8	44.2	0.4			46.7	2.1	5:1
Siberian											49.2	0.9	48.4	2.2	50.1	3.1			49.2	2.1	23:1
English Wonder	46.3	-0.2	80.7	5.4	46.7	1.8	47.8	3.7	68.4	6.4	39.0	-4.6	47.5	-0.7	51.2	4.6			53.4	2.0	12:1
Jefferson County 343									52.6	3.7	46.2	0.2	50.2	3.2	51.9	4.7	42.8	-1.7	48.7	2.0	11:1
Swedish Victory							49.7	2.2	64.2	10.2	47.2	-1.4	50.0	0.9	52.3	1.5	52.2	-1.8	52.6	1.9	5:1
Great Northern Sel. 130-48											47.6	4.1	49.0	0.9	45.2	0.7			47.3	1.9	8:1
Golden Wonder	52.5	4.6	74.8	-0.2	42.9	-4.1	47.6	1.3	59.8	7.3									55.5	1.8	4:1
Canada Cluster Sel. 110-7			79.6	4.3	49.7	4.0	46.5	-4.6	63.8	8.1	42.4	-0.4	47.7	-1.0					54.9	1.7	4:1
Great Northern	48.9	1.0	78.9	4.2	43.5	-0.6	47.9	-3.7	63.0	8.1	48.4	6.4	48.1	0.4	42.8	-2.4			52.7	1.7	6:1
Emperor William	44.2	-1.8	73.0	-2.4	46.7	2.1	49.7	5.3	66.8	5.1									50.1	1.7	4:1
President Sel. 129-81									57.8	4.1	48.0	0.0	48.1	1.1					51.3	1.7	6:1
Early Gothland (Minn. 26)	43.0	-2.2	73.4	-2.3	45.8	0.9	51.1	4.9	65.6	6.8									55.8	1.6	4:1
Great Northern Sel. 130-33											48.4	4.6	48.1	0.1	45.0	0.2			47.2	1.6	4:1
State Selection 133-10													54.5	1.8	47.6	2.6	51.9	0.4	51.3	1.6	14:1
Great Northern Sel. 130-68									58.6	7.3	43.4	-0.8	46.1	-2.3					49.4	1.4	2:1
American Banner	39.9	-5.9	80.4	4.1	46.1	-2.4	56.8	9.9	59.8	6.1	42.6	-3.5	49.0	0.5					53.5	1.3	3:1
Silvermine Sel. 125-4	43.0	0.7	78.7	4.9	47.4	1.3	48.6	-0.8	71.6	7.5	39.4	-5.8	49.2	0.4					54.0	1.2	3:1

TABLE 1 (*concluded*)

Variety	1914		1915		1916		1917		1918		1919		1920		1921		1922		Average		Odds
	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	Bushels per acre	Gain or loss	
Silvermine Sel. 118-7	47.1	0.8	76.2	0.7	45.7	1.1	44.2	-0.7	64.6	4.0	....	....	....	....	....	....	....	....	55.6	1.2	10:1
National Sel. 127-15	....	....	....	....	....	....	....	....	61.8	1.7	43.8	-0.6	48.9	2.5	....	....	....	....	51.5	1.2	5:1
National Sel. 128-34	....	....	....	....	....	....	....	....	65.4	2.1	46.4	2.1	46.0	-0.6	....	....	....	....	52.6	1.2	5:1
President Sel. 129-74	....	....	....	....	....	....	....	....	57.2	3.3	47.6	-0.4	47.1	0.3	....	....	....	....	50.6	1.1	4:1
National Sel. 127-16	....	....	....	....	....	....	....	....	61.8	1.3	47.2	2.9	45.5	-1.0	....	....	....	....	51.5	1.1	4:1
New Zealand	....	....	72.5	2.0	48.7	3.3	46.7	-3.6	61.4	5.6	44.0	1.4	42.7	-2.9	....	....	....	....	52.7	1.0	3:1
Great Northern Sel. 130-54	....	....	....	....	....	....	....	....	61.6	9.9	39.2	-4.6	46.0	-2.2	....	....	....	....	48.9	1.0	1:1
Comewell	46.1	-0.7	80.4	6.2	48.9	3.1	45.3	-2.4	66.2	2.9	42.8	-2.0	47.9	-0.8	....	....	....	....	53.9	0.9	3:1
Empire	....	....	80.4	2.6	45.3	-1.6	48.0	0.2	58.6	4.3	48.4	1.5	45.9	-3.0	50.1	-1.2	52.7	3.0	53.7	0.7	3:1
White Spring Oats	45.6	2.0	72.9	-2.4	45.0	0.2	44.2	0.5	65.2	3.3	....	....	....	....	....	....	....	....	54.6	0.7	3:1
Standwell	....	....	80.6	5.0	48.2	-2.4	46.5	-1.9	53.0	1.0	47.4	1.1	52.2	5.2	52.5	1.9	48.4	-4.5	53.6	0.7	2:1
Silvermine	44.2	-3.5	76.6	2.1	44.9	1.4	48.3	-3.8	54.6	4.5	48.2	3.1	46.9	-1.3	52.1	4.2	52.3	-0.2	52.0	0.7	3:1
Peerless	....	....	....	....	....	....	44.8	-7.3	62.6	4.8	47.4	5.2	45.7	0.0	....	....	....	....	50.1	0.7	1:1
Silvermine Sel. 125-20	43.1	-3.4	76.2	1.9	49.2	3.6	45.2	-0.7	69.8	6.6	41.8	-2.6	47.5	-1.0	....	....	....	....	53.3	0.6	2:1
Big Four Sel. 115-27	....	....	76.4	-0.8	48.8	1.3	49.7	1.6	58.4	3.2	45.0	-1.7	47.9	-1.0	....	....	....	....	54.4	0.4	2:1
Gold Rain	....	....	....	....	....	....	....	....	....	....	....	....	55.2	7.8	46.8	0.7	47.8	-7.3	49.9	0.4	1:1
Siberian	43.9	-1.7	75.1	0.0	46.0	-0.9	45.9	-0.6	53.2	4.7	....	....	....	....	....	....	....	....	52.8	0.3	2:1
Conqueror	....	....	73.7	-2.2	45.3	-2.0	47.2	-1.0	56.2	6.3	....	....	....	....	....	....	....	....	55.6	0.3	1:1
National	46.6	2.4	77.1	2.1	40.7	-3.9	45.3	-6.1	59.4	4.6	43.0	1.0	48.9	1.4	....	....	....	....	51.6	0.2	1:1
Rejuvenated White Bonanza	42.3	-6.8	72.8	-3.1	48.4	1.4	45.5	1.4	56.0	7.8	....	....	....	....	....	....	....	....	53.0	0.1	<1:1
Silvermine Sel. 120-9	45.8	-1.4	75.2	0.3	47.3	2.1	39.6	-5.4	74.6	11.7	40.8	-3.2	44.4	-4.0	....	....	....	....	52.5	0.0	....
Maine Selection 355	....	....	....	....	....	....	....	....	....	....	46.0	-0.3	51.7	0.6	47.8	-0.2	....	....	48.5	0.0	....
Improved American	....	....	....	....	....	....	....	....	65.8	2.3	43.4	-1.9	45.8	-1.3	....	....	....	....	51.7	-0.3	1:1
National Sel. 127-17	....	....	....	....	....	....	....	....	60.0	-1.1	45.0	0.7	45.2	-1.3	....	....	....	....	50.1	-0.6	3:1
Currell's No. 6	....	....	73.3	0.6	44.7	0.9	41.5	-7.6	53.4	3.6	....	....	....	....	....	....	....	....	53.2	-0.6	1:1
Victory (from Svalöf, Sweden)	44.4	-7.6	74.8	-0.6	45.6	-1.1	45.9	-0.6	53.6	5.3	....	....	....	....	....	....	....	....	52.9	-0.9	2:1
Early New Market	....	....	....	....	....	....	55.9	2.8	58.0	-2.7	42.2	-0.8	43.2	-3.0	....	....	....	....	49.8	-0.9	3:1
Maine Selection 340	....	....	....	....	....	....	....	....	....	....	46.6	0.3	48.8	-2.0	47.6	-1.0	....	....	47.7	-0.9	5:1
Victory	....	....	78.5	1.9	43.2	-4.9	46.4	-1.5	51.6	2.0	....	....	47.7	-5.9	52.5	2.7	51.6	-1.3	53.1	-1.0	3:1
State Selection 133-9	....	....	....	....	....	....	....	....	....	....	....	....	47.1	0.4	46.2	1.1	47.4	-4.8	46.9	-1.1	2:1
Michigan Wonder	40.5	-3.1	76.8	2.0	41.1	-7.5	44.5	-1.9	56.8	3.5	....	....	....	....	....	....	....	....	51.9	-1.4	3:1
Big Four Sel. 115-30	....	....	77.1	-0.3	42.5	-4.8	47.3	-0.7	54.6	-0.2	....	....	....	....	....	....	....	....	55.4	-1.5	7:1
White Tartar King	....	....	....	....	....	....	50.9	-2.5	57.2	-4.1	43.4	0.2	46.9	0.5	....	....	....	....	49.6	-1.5	7:1
Heavy Weight	45.1	-2.9	72.2	-3.6	43.5	-1.5	42.3	-4.6	62.4	4.2	....	....	....	....	....	....	....	....	53.1	-1.7	5:1
Burt	43.6	-0.8	62.8	-11.3	53.4	6.6	....	....	....	....	....	....	....	....	....	....	....	....	53.3	-1.8	2:1
Danish Island	....	....	....	....	....	....	....	....	54.6	-0.2	39.4	-6.1	49.7	0.3	....	....	....	....	47.9	-2.0	4:1
Wisconsin No. 1	40.9	-0.5	72.3	-4.4	45.8	-2.3	46.9	-0.8	54.2	-1.4	....	....	....	....	....	....	49.6	-3.0	51.6	-2.1	109:1
Yellow Oats Yvois	48.5	1.7	74.5	-2.3	42.7	-5.2	45.0	-3.2	54.8	-1.3	....	....	....	....	....	....	....	....	53.1	-2.1	13:1
Yellow Oats Flanders	40.8	-6.1	80.4	3.5	40.6	-7.3	43.4	-4.4	52.4	2.7	....	....	....	....	....	....	....	....	51.5	-2.3	4:1
Sixty Day Sel. 5938-1	51.6	5.5	73.6	-1.2	43.4	-4.1	47.7	-6.6	66.8	-1.3	43.8	-1.0	49.9	-7.3	....	....	....	....	53.8	-2.3	9:1
White Seed	....	....	....	....	....	....	....	....	56.8	-1.9	44.0	-2.8	44.1	-2.6	....	....	....	....	48.3	-2.4	146:1
National Sel. 128-36	....	....	....	....	....	....	....	....	59.4	-4.5	44.0	-0.3	44.4	-2.3	....	....	....	....	49.3	-2.4	10:1
Worthy Oats	....	....	....	....	....	....	38.2	-14.9	60.8	0.4	45.8	3.1	47.5	1.4	....	....	....	....	48.1	-2.5	2:1

President	40.4	-2.8	70.2	-4.9	46.2	-3.3	40.8	-5.5	53.8	0.9	46.8	-0.9	44.9	-1.6	....	....	....	....	49.0	-2.6	87:1
Big Four Sel. 115-34	....	....	77.4	-0.1	44.6	-2.5	42.1	-5.7	51.6	-2.9	....	....	....	....	....	....	....	....	53.9	-2.8	20:1
Lincoln	42.1	-5.6	72.3	-2.9	47.2	-2.5	40.1	-7.8	54.2	0.8	45.4	-2.7	49.1	1.3	....	....	....	....	50.1	-2.8	32:1
Alberta	....	....	71.7	-3.5	42.5	-3.9	43.0	-5.6	54.0	0.8	....	....	....	....	....	....	....	....	52.8	-3.0	16:1
White Side	....	....	....	....	....	....	....	....	57.2	-1.3	40.8	-6.1	45.0	-1.7	....	....	....	....	47.7	-3.0	10:1
Progress	41.5	-2.4	75.1	-1.1	39.1	-8.7	41.2	-5.4	55.0	1.9	....	....	....	....	....	....	....	....	50.4	-3.1	11:1
Anderbeck	42.1	-7.7	72.9	-2.8	44.1	-2.8	41.5	-5.3	50.4	2.2	....	....	....	....	....	....	....	....	50.2	-3.3	16:1
Wisconsin No. 5	....	....	....	....	....	....	....	....	....	....	....	....	48.1	0.2	47.7	-3.3	44.8	-8.4	46.9	-3.8	7:1
Shadeland Climax	....	....	....	....	....	....	46.1	-6.2	57.2	-2.6	40.8	-1.7	40.2	-5.7	....	....	....	....	46.1	-4.0	51:1
Junghaus	....	....	70.0	-5.5	42.6	-4.3	43.8	-4.6	48.2	-1.9	....	....	....	....	....	....	....	....	51.1	-4.1	158:1
Wisconsin No. 4	38.2	-6.6	77.1	0.8	37.1	-7.0	43.6	-4.5	52.4	-3.9	....	....	....	....	....	....	....	....	49.7	-4.2	49:1
Big Four	45.1	-3.1	71.0	-6.0	40.9	-6.8	45.4	-3.0	53.4	-2.2	41.2	-5.3	44.8	-4.0	....	....	....	....	48.8	-4.3	3,332:1
Abundance	39.6	-7.3	....	....	39.6	-6.5	44.0	-6.9	61.2	3.0	....	....	....	....	....	....	....	....	46.1	-4.4	10:1
Svalöf Gold Rain	41.7	-9.6	71.0	-3.9	42.6	-3.0	43.9	-3.2	52.4	-3.0	....	....	....	....	....	....	....	....	50.3	-4.5	79:1
Swedish Select	45.3	-2.4	....	....	....	....	40.8	-11.4	58.2	3.2	40.6	-5.2	43.7	-5.3	43.3	-6.2	47.0	-5.7	45.6	-4.7	63:1
Tartarian	43.8	-6.7	72.6	-2.7	39.3	-8.0	37.2	-9.1	50.8	2.4	....	....	....	....	....	....	....	....	48.7	-4.8	23:1
Old Island Black	....	....	69.8	-3.3	39.1	-4.9	37.9	-11.0	49.8	0.1	....	....	....	....	....	....	....	....	49.1	-4.8	14:1
Beardless Probsteier	38.6	-6.7	....	....	....	....	40.1	-8.0	54.2	-0.1	....	....	....	....	....	....	....	....	44.3	-4.9	10:1
Rutledge Prize	....	....	65.8	-8.3	43.7	-1.2	40.7	-8.3	48.0	-1.7	....	....	....	....	....	....	....	....	49.5	-4.9	22:1
Beseler II	41.0	-9.1	75.3	-0.9	39.3	-7.9	42.2	-4.8	46.2	-2.2	....	....	....	....	....	....	....	....	48.8	-5.0	60:1
Clydesdale	44.7	-3.0	70.2	-7.9	37.4	-8.8	43.2	-4.6	50.2	-3.9	43.8	-3.2	43.6	-5.3	....	....	....	....	47.6	-5.2	1,999:1
Swedish Red	....	....	....	....	....	....	....	....	42.2	-17.0	45.2	-1.5	49.0	2.2	....	....	....	....	45.5	-5.4	3:1
Scottish Chief	....	....	65.9	-8.9	41.8	-4.1	39.5	-9.4	49.8	0.3	....	....	....	....	....	....	....	....	49.2	-5.5	20:1
Svalöf Ligowo	41.5	-9.5	73.6	-0.9	37.9	-8.5	37.1	-9.6	52.2	-2.7	....	....	....	....	....	....	....	....	48.5	-6.2	72:1
Daubeney	48.4	5.9	65.1	-10.8	....	....	42.9	-10.5	42.6	-10.0	....	....	....	....	....	....	....	....	49.7	-6.3	8:1
Watson	37.5	-3.5	68.9	-9.1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	53.2	-6.3	7:1
Garton's No. 5	35.2	-11.0	67.2	-8.3	40.4	-5.0	44.4	-5.5	54.8	-2.0	....	....	....	....	....	....	....	....	48.4	-6.4	144:1
Polish Oats	40.5	-6.6	66.7	-9.1	45.8	0.7	43.0	-4.8	44.8	-12.8	....	....	....	....	....	....	....	....	48.2	-6.5	44:1
Shadeland Eclipse	....	....	....	....	....	....	51.7	-2.2	50.2	-11.5	37.8	-5.9	40.0	-6.5	....	....	....	....	44.9	-6.5	45:1
King	33.2	-14.0	71.7	-3.8	37.7	-7.8	48.1	-2.8	48.8	-7.3	....	....	....	....	....	....	....	....	47.9	-7.1	87:1
Sixty Day (U. S. 1701)	52.9	4.6	59.9	-16.0	48.5	2.3	32.1	-21.4	47.6	-8.5	....	....	....	....	....	....	....	....	48.2	-7.8	9:1
White Tartar King	....	....	....	....	....	....	....	....	48.0	-13.6	38.6	-7.9	45.1	-1.8	....	....	....	....	43.9	-7.8	12:1
Canada Cluster	....	....	62.7	-10.7	34.1	-10.4	39.3	-9.8	48.6	-1.0	....	....	....	....	....	....	....	....	46.2	-8.0	48:1
Svalöf Probsteier	36.3	-15.6	67.1	-9.4	37.9	-9.5	39.0	-8.2	50.4	1.6	....	....	....	....	....	....	....	....	46.1	-8.2	49:1
Alberta Cluster	....	....	....	....	....	....	32.3	-16.5	49.6	-0.3	....	....	....	....	....	....	....	....	40.9	-8.4	3:1
White Kherson	....	....	....	....	....	....	45.7	-5.9	50.0	-7.3	39.4	-6.2	42.3	-14.9	....	....	....	....	44.3	-8.6	73:1
June	47.8	-3.1	52.1	-23.8	53.3	7.1	33.8	-19.7	41.8	-11.0	....	....	....	....	....	....	....	....	45.8	-10.1	13:1
Ligowo	49.4	0.8	67.2	-8.4	41.9	-4.9	35.5	-17.5	48.2	-12.4	39.0	-8.1	36.0	-21.2	....	....	....	....	45.3	-10.2	163:1
Mammoth Cluster	....	....	....	....	....	....	....	....	39.4	-15.9	39.8	-7.2	43.4	-3.2	41.3	-6.4	34.2	-19.9	39.6	-10.5	66:1
Garton's No. 6	26.5	-20.0	62.5	-12.1	33.3	-13.8	38.0	-8.6	53.6	-0.8	....	....	....	....	....	....	....	....	42.8	-11.1	79:1
Excelsior	30.8	-12.1	59.4	-16.2	37.4	-7.9	36.8	-12.1	47.4	-9.6	....	....	....	....	....	....	....	....	42.4	-11.6	1,666:1
Svalöf Dala	21.9	-30.4	63.9	-12.9	39.3	-8.3	41.4	-5.9	40.8	-1.1	....	....	....	....	....	....	....	....	41.5	-11.7	23:1
Bumper Crop	30.5	-19.5	66.9	-7.8	38.9	-9.0	29.1	-17.4	40.6	-7.8	....	....	....	....	....	....	....	....	41.2	-12.3	232:1
Duffan	29.9	-19.5	....	....	30.7	15.0	33.9	-16.7	48.0	1.0	....	....	....	....	....	....	....	....	35.6	-12.5	26:1
Bergs	31.2	-10.9	57.9	-16.0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.5	-13.4	16:1
O. A. C. No. 3	....	....	....	....	....	....	....	....	48.8	-14.4	38.4	-6.7	38.0	-19.2	....	....	....	....	41.7	-13.4	29:1
Storm King	....	....	64.4	-12.8	26.8	-16.5	....	....	45.0	-12.0	....	....	....	....	....	....	....	....	45.4	-13.8	199:1
Long's White Tartar	....	....	....	....	....	....	32.7	-17.3	44.8	-10.6	....	....	....	....	....	....	....	....	38.7	-13.9	12:1
Imported Storm King	....	....	....	....	....	....	31.7	-16.7	44.8	-12.0	....	....	....	....	....	....	....	....	38.2	-14.3	18:1
Fulghum	....	....	....	....	....	....	35.5	-18.0	51.4	-10.8	....	....	....	....	....	....	....	....	43.4	-14.4	12:1
Senator	....	....	....	....	....	....	32.6	-21.0	52.8	-10.3	....	....	....	....	....	....	....	....	42.7	-15.6	8:1
Svalöf Moss	35.9	-15.5	55.8	-17.8	34.8	-11.6	32.2	-19.7	48.2	-16.5	....	....	....	....	....	....	....	....	41.4	-16.2	9,999:1
Svalöf Black Bell	17.5	-34.2	63.2	-13.8	28.3	-19.5	....	....	....	....	....	....	....	....	....	....	....	....	36.3	-22.5	29:1
Shadeland Hulless	....	....	....	....	....	....	38.5	-15.3	44.2	-18.1	22.0	-21.4	12.1	-35.5	....	....	....	....	29.2	-22.6	131:1

Gold Mine and Swedish Select for 1914, the gain or loss as compared with the check will show which is the better variety for that year. Here Gold Mine showed a gain of 3.5 bushels, and Swedish Select a loss of 2.4 bushels. Since both sorts are compared with the same check, it may be concluded that, for the conditions under which these two were grown in 1914, Gold Mine probably is a better variety than Swedish Select.

The table shows also the average yield for each sort for the number of years under test, and the average gain or loss as compared with the check.

The last column of the table shows the mathematical assurance that the gain or loss is one on which some reliance may be placed. It is not the intention here to go into detail as to how this was determined, but merely to make a statement as to the meaning. These odds may be thought of as a chance, or bet, that a certain result may occur. Usually in such work the chance, or odds, should be about 30:1 if much confidence is to be placed in the results. The first strain in the table, State Selection 133–46, shows a gain of 10.5 bushels over the check, and the odds are 102:1 that this result is mathematically significant. On the other hand, the variety Emperor William shows a gain of 1.7 bushels over the check, but the odds are only 4:1 that this is a significant difference. From these odds one would conclude that State Selection 133–46 is a much better sort than Emperor William. Generally speaking, unless a variety shows a yield from 2.5 to 3 bushels, at least, more or less than the check, it is concluded that the variety is of about the same value as the check, so far as yield is concerned.

An examination of these results shows that State Selection 133–46, Cornellian, and National Selection 127–9 head the list, so far as the average gain over the check is concerned. The first two are outstanding in that their gain is 10.5 and 10.2 bushels, respectively, while for National Selection 127–9 the gain is only 5.3 bushels. The fact that Cornellian has been under test longer than State Selection 133–46 indicates that it is a dependable variety. The oat named O. A. C. No. 72 stands fourth on the list. This oat is the result of a selection made by Dr. C. A. Zavitz, of the Ontario Agricultural College at Guelph, Canada.

Certain varieties, as Gold Mine, Siberian, English Wonder, Great Northern, Emperor William, American Banner, Silvermine, National, Victory, Heavy Weight, Big Four, Abundance, Swedish Select, Clydesdale, Mammoth Cluster, and Bumper Crop, do not yield so well as the sorts mentioned above. The strains that have been developed by breeding outyield the standard varieties, as shown by these results.

RESULTS FROM ADVANCED TEST, 1922 TO 1924

As already stated, an advanced test is conducted every year, in which some of the better strains and varieties are compared as to yield. The results from the sorts that were under test for the years 1922 to 1924 are given in table 2.

The average yield for the three years shows that Cornellian ranks first, with National Selection 127–9 second. The selection from Twentieth Century (108–27) ranks last, with a yield of 63.6 bushels per acre, which is 6.5 bushels less than that of Cornellian. Victory is only 2.6 bushels behind Cornellian. These results again show the importance of Cornellian so far as yield is concerned.

TABLE 2. RESULTS FROM ADVANCED TEST CONDUCTED AT ITHACA DURING THE YEARS 1922 TO 1924

Variety	Average yield for the three years (bushels per acre)
Cornellian	70.1
National Sel. 127-9	68.7
Jefferson County 343	67.8
Victory	67.5
Standwell	67.3
Empire	66.2
Twentieth Century 108-27	63.6

TESTS MADE IN VARIOUS PARTS OF THE STATE, 1921 TO 1923

In addition to the extensive experiments that have been conducted on the experiment station farm at Ithaca, a number of tests have been made in various counties of the State. The plan followed in these tests has been to place them in various counties where oats are grown to a considerable extent. In selecting these counties, consideration was given also to the different soil and climatic factors. The counties in which these tests have been conducted for the past three years are Jefferson, St. Lawrence, Lewis, Delaware, Dutchess, Ontario, Genesee, Madison, and Schoharie.

The strains used were those that have shown promise in the experiments at Ithaca, together with some of the commercial varieties that are being grown or offered for sale in the State. In addition, for comparison, a side oat was included. The results for the years 1921 to 1923, together with the average yield for these three years, are given in table 3.

TABLE 3. RESULTS OBTAINED FROM THE OAT TESTS MADE IN VARIOUS COUNTIES THROUGHOUT NEW YORK

(The averages are given for each year)

Variety	Yield in 1921 (bushels per acre)	Yield in 1922 (bushels per acre)	Yield in 1923 (bushels per acre)	Average yield for the three years (bushels per acre)
Cornellian	47.7	56.6	63.8	56.0
National Sel. 127-9	46.9	53.0	65.8	55.2
Empire	44.6	51.8	63.8	53.4
Standwell	45.2	49.1	62.5	52.3
Comewell	44.6	47.6	63.5	51.9
Jefferson County 343	44.5	47.0	61.9	51.1
Victory	42.5	49.8	61.0	51.1
Wolverine	36.9	49.6	66.2	50.9
College Wonder	40.2	47.7	61.6	49.8
Side oats	37.0	39.9	54.9	43.9

FIGURE 4. A FIELD OF STANDWELL OATS GROWN ON THE FARM OF O. R. ROBSON
This field yielded more than 89 bushels per acre

These results show that the variety Cornellian led in two years out of the three. In 1923 it was exceeded by Wolverine and by National Selection 127–9. This was no doubt due to the fact that Cornellian was somewhat earlier than the other sorts and, since these plats were located at a considerable distance from Ithaca, it was not always possible to harvest them at exactly the proper time. It has been noted by the men in charge of the work that in some of these fields the Cornellian has lost considerably from shattering. Even in spite of the good showing of Wolverine

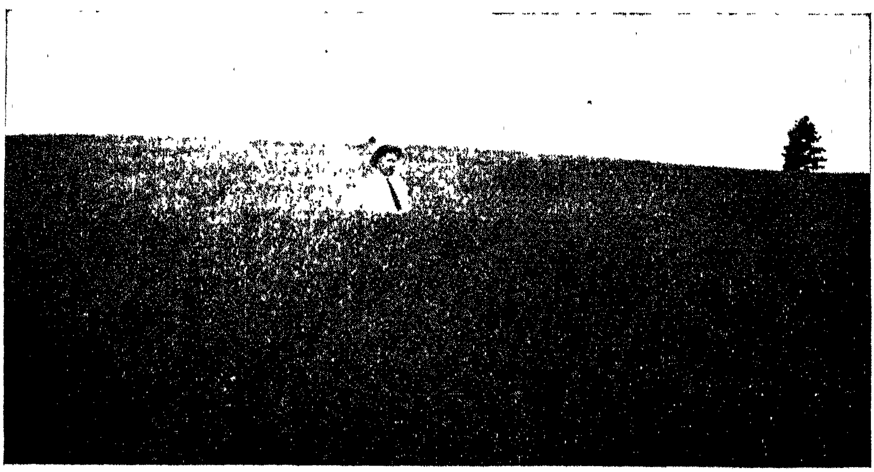

FIGURE 5. A FIELD OF CORNELLIAN OATS

in 1923, the three-years average shows the Cornellian to be more than five bushels better than that variety. Selection 127–9 from the National variety ranks next to Cornellian in yield. The yield of the side oat was 12.1 bushels less, on the average, than that of Cornellian. From these experiments it is clear that side oats, which have been shown to be poor yielders in the experiments at Ithaca, do not yield well in any part of the State.

Fields of Standwell and Cornellian oats are shown in figures 4 and 5.

IMPORTANCE OF SELECTION

The table giving the yields (table 1) shows that the sorts which are outstanding in yield are the result of individual plant selections. That is, by selecting a very large number of individual plants from a variety or a field, and testing the behavior of the progeny of each plant separately for several years, one may find some high-yielding strains. Of course, many that are selected will prove to be of no value. It is only rarely that a very high-yielding strain is obtained. Several hundred selections may be made and only a single good strain obtained.

The variation that occurs between different selections from the same variety is shown in table 4. Only twenty selections out of a large number that were made are reported here.

In the first year of the test (1915), the rows were short and the yields are given in grams rather than in bushels per acre. The variation in yield ranges from 102 grams to 169 grams per row. Little importance can be given to such results, however, since the rows were short and were not replicated.

In the second year of the test, the selections were all compared with a standard variety used as a check, and the gain or loss in relation to the check furnishes a very good means of comparing the strains. The twenty selections reported here show a gain ranging from 2.1 to 13.6 bushels per acre. These selections were all continued under test in 1917. Again the comparison of the different selections as to gain or loss in relation to the check shows great variation. One selection shows a loss of 4.2 bushels, and another a gain of 14.7 bushels, per acre. This is a very wide range, and indicates the variability that may be expected when a number of selections are made from the same variety or field. At the end of two or three years the number of selections may be materially reduced by discarding the poorer ones or those that do not consistently give a high yield. This plan was followed with the selections included in this table. Six selections out of twenty were continued through 1918, 1919, and 1920. After 1920 only one was continued.

It is interesting to note that Selection 127–9 and Selection 127–15 gave about the same increase over the check in 1917. In later years, however, 127–15 did not continue to give any decided increase over the check, while 127–9 continued to show a gain. For the three years from 1918 to 1920 the average gain for Selection 127–9 was 6.4 bushels while that for 127–15 was only 1.2 bushels per acre. This emphasizes the importance of testing a large number of selections, and continuing the test long enough to determine whether the outstanding selections are consistently good or whether an unusually high yield one year may be due to an especially favorable location in the field. In this case, apparently

TABLE 4. BEHAVIOR OF A NUMBER OF INDIVIDUAL SELECTIONS FROM THE SAME VARIETY OF OATS

Strain	1915	1916		1917		1918		1919		1920		1921		1922	
	Head row (grams)	Bushels per acre	Gain or loss*	Bushels per acre	Gain or loss*	Bushels per acre	Gain or loss*	Bushels per acre	Gain or loss*	Bushels per acre	Gain or loss*	Bushels per acre	Gain or loss*	Bushels per acre	Gain or loss*
National Selection															
127– 1	130	48.7	9.6	57.1	1.7										
– 2	126	50.9	12.1	58.9	3.9										
– 3	116	49.9	11.3	61.4	6.8	65.0	7.1	47.0	3.1	46.8	0.3				
– 4	129	52.0	13.6	59.6	5.4	63.4	4.8	48.0	3.8	46.6	0.3				
– 5	141	46.7	8.5	56.6	2.9										
– 6	132	45.3	7.3	53.8	0.5										
– 7	120	44.3	6.2	52.6	–0.3										
– 8	138	47.7	9.3	58.7	6.2										
– 9	102	51.8	13.1	66.8	14.7	67.8	8.5	51.6	9.0	48.2	1.6	55.0	4.1	53.1	3.4
–10	105	41.1	2.1	55.2	2.9										
–11	121	51.3	12.1	57.2	4.2										
–12	132	50.3	10.8	54.9	1.3										
–13	120	48.3	8.5	56.5	2.3										
–14	123	48.6	8.5	60.2	5.4										
–15	127	45.1	4.7	69.5	14.0	61.8	1.7	43.8	–0.6	48.9	2.5				
–16	148	51.1	11.0	66.6	10.5	61.8	1.3	47.2	2.9	45.5	–1.0				
–17	133	46.5	7.0	66.2	9.5	60.0	–1.1	45.0	0.7	45.2	–1.3				
–18	169	46.2	7.4	63.5	6.1										
–19	132	42.1	3.9	54.2	–4.2										
–20	118	45.5	7.9	61.8	3.1										

* As compared with check.

the very high gain for Selection 127–15 in 1917 was due to favorable conditions rather than to the fact that 127–15 was an unusually good selection. After the test of 1922, Selection 127–9 was put in the advanced test, where it could be tested under the severest conditions.

EARLY OATS COMPARED WITH MID-SEASON OATS

Another point brought out by the results in table 1 is the fact that, as a rule, early oats do not yield so well as do the medium-season or later oats. There are certain years when a good strain of early oats will do very well. A comparison between three varieties of early oats and three commercial varieties of medium-season oats for the years 1918 to 1920 is shown in table 5; also, for comparison, the yield of the variety Cornellian is given for the same three years.

TABLE 5. COMPARATIVE YIELDS, FOR THREE YEARS, OF THREE VARIETIES OF EARLY OATS AND THREE VARIETIES OF MEDIUM-SEASON OATS

(The yield for Cornellian for the same years is given also)

Variety	Yield in bushels per acre			Average for three years
	1918	1919	1920	
Early oats:				
White Kherson	50.0	39.4	42.3	43.9
O. A. C. No. 3	48.8	38.4	38.0	41.7
Ligowo	48.2	39.0	36.0	41.1
Average	49.0	38.9	38.8	42.2
Medium-season oats:				
Silvermine	54.6	48.2	46.9	49.9
Swedish Select	58.2	40.6	43.7	47.5
American Banner	59.8	42.6	49.0	50.5
Average	57.5	43.8	46.5	49.3
Cornellian (medium-season)	65.8	52.4	57.3	58.5

The average for the early oats for the three years is 42.2 bushels per acre, and that for the mid-season varieties 49.3 bushels, showing a gain of 7.1 bushels in favor of the later oats. When the earlier strains are compared with Cornellian, which is also a mid-season variety, the difference is much greater.

These results prove that early oats will not do so well as later sorts for the conditions under which these oats were grown. From trials in different parts of the State, it is evident that the earliest oats are not the best varieties for New York conditions.

HULL-LESS OATS

Some interest in hull-less oats is manifested by certain growers. The hull-less oat is one in which the kernel, or meat (caryopsis), is held loosely in the hulls or glumes, so that on threshing, the meat is obtained free from

any adhering hulls. In order to determine the value of such types, a number of hull-less varieties were tried in the tests. The results of the trial of one of these varieties, which is typical of the hull-less oats in general, are given in table 1. This oat, the Shadeland Hulless, gave an average yield for the four years from 1917 to 1920, of 29.2 bushels per acre. This yield is all oat meats, however, and, since oats average about 70 per cent of meats, it is equivalent to about 42 bushels per acre of ordinary oats. During the same period, Silvermine yielded 49.5 bushels per acre. This indicates that the hull-less type, when compared with a good ordinary oat, will not yield so well. For certain uses, as, for example, poultry feeding, it may be worth while to sacrifice some yield to obtain the kernels without hulls. It should be pointed out that the hull-less types are more difficult to store than are the hulled oats, and usually are very susceptible to smut.

SIDE- AND SPREADING-PANICLE TYPES

There are two distinct types of oats so far as panicle shape is concerned. One is the side, or horse-mane, type. The branches of this type all extend

FIGURE 6. TYPES OF SIDE- AND SPREADING-PANICLE OATS

upward and out to one side of the rachis, and give the head a very characteristic fan-shaped appearance. The other type has the branches spreading out on all sides of the rachis, and the head resembles a tree in shape. Sometimes this type is called the *tree-oat*. Within each type there are slight variations as to form, but these are not differentiated in the yield tests.

The side oats are very deceiving when seen growing in the field. The heads are long, and the varieties look as though they would yield very high. On the contrary they are very low yielders, at least for New York conditions. Most of the side oats do not tiller out well, that is, they do not develop as many culms, or stalks, on a single plant as do the spreading types. Because of this, they do not fill up the ground so well in the field, and a low yield results. Another objectionable feature is that some of the varieties of side oats have an abnormally bent node near the base of the head, which causes many of the heads to break off at maturity, thereby causing a loss (figure 6).

The comparison in yield between four varieties of oats with spreading panicle and four varieties with side panicle is shown in table 6. The

TABLE 6. YIELD OF FOUR VARIETIES EACH OF THE TYPES CLASSED AS SPREADING-PANICLE AND SIDE-PANICLE, RESPECTIVELY

Variety and type	Yield in bushels per acre		
	1917	1918	Average for two years
Spreading-panicle:			
American Banner	56.8	59.8	58.3
Silvermine	48.3	54.6	51.4
Swedish Select	40 8	58.2	49.5
Lincoln	40 1	54.2	47.1
Average	46 5	56 7	51.6
Side-panicle:			
Canada Cluster	39 3	48.6	43.9
Old Island Black	37.9	49.8	43.8
Senator	32.6	52.8	42.7
Imported Storm King	31 7	44 8	38.2
Average	35.4	49.0	42 1

results are given for the years 1917 and 1918 because these were the only years in which all the sorts were grown. In 1917 the average of the types with spreading panicle was 46.5 bushels per acre, while those having the side panicle gave an average of 35.4 bushels per acre. The averages for the same types in 1918 were 56.7 and 49.0, respectively.

The general average for the two years was 51.6 bushels per acre for the spreading-panicle type and 42.1 for the side-panicle type, a difference of 9.5 bushels in favor of the spreading-panicle type. The yields obtained from these side oats, and from others in several additional tests, show conclusively that side oats are not so good yielders as the spreading-

or open-panicle type. For several years seed was sown of a number of varieties that had been tested for yield and had proved to be low yielders. This series of poor varieties was made up largely of side-oat sorts.

WEIGHT PER BUSHEL

The weight per bushel, in pounds, of the different varieties has been recorded for a number of years. The weight taken is that of the cleaned grain after it is thoroughly dry. All varieties are cleaned in the same manner, so that the weights represent the difference between the various sorts for this character.

The weight per bushel is greatly influenced by the season and the soil. In some years, when the environment is unfavorable, the oats do not fill well and the weight per bushel is low. In a favorable season for oats, the weight per bushel will be high. During the several years when weight has been taken, the range has been from about 26 to 36 pounds per bushel, as an average for all the varieties.

The results of the tests emphasize the fact that weight per bushel in itself is not of great importance, since it varies considerably with the season, and high weight per bushel is not always associated with high yield per acre. In fact, the results obtained show that there is little or no relation between weight per bushel and yield. Some varieties may have a high weight per bushel and yet not yield especially well. The relation between yield per acre and weight per bushel for several years is shown in table 7. The figures give the correlation between the two characters.

TABLE 7. CORRELATION BETWEEN YIELD OF GRAIN, PER ACRE, AND WEIGHT PER BUSHEL

Year	Coefficient of correlation and probable error
1915	0.257 ± 0.053
1916	0.093 ± 0.058
1917	−0.191 ± 0.053
1918	−0.128 ± 0.045
1919	0.062 ± 0.053
1920	−0.196 ± 0.082
1921	−0.070 ± 0.073

It is not necessary to discuss these results in detail. It may be pointed out, however, that the highest value which the correlation coefficient may have is plus or minus 1. Such a value would show a perfect relation between two characters. As the relationship between two characters becomes less definite, the value decreases from 1 and approaches 0. The size of the probable error also is of importance, since, unless a coefficient of correlation is more than four or five times its probable error, the coefficient does not show any pronounced relationship.

The fact that all of these values are low indicates that weight per bushel is not an important character in denoting the value of an oat. Furthermore, a variety that gives a high weight per bushel one year may not be

particularly high in yield another year. Seasonal and environmental influences are so important that little value can be placed on weight per bushel. The shape of kernel also has an effect on the weight per bushel. The longer kernels do not pack so well in the measure, thus leaving more air space and hence giving a lighter weight than is obtained with the shorter kernels. The kernels that are shorter in comparison to their width give a higher weight per bushel. The point to be considered, however, is, what type will give the greatest yield per acre by weight, rather than what variety will give the greatest weight per bushel.

PERCENTAGE OF MEAT OR KERNEL

One of the most important considerations regarding an oat variety is whether it is one that produces a large amount of meat, or kernel, in proportion to the hull. This is of particular importance in New York, since such a large proportion of the crop is fed on the farm. It is of importance also if oats are to be sold, since oats that have a high percentage of meat will be of better quality and will give a good weight per bushel. There is a great difference between varieties in this respect, some having only 60 per cent of meat, or 60 pounds of meat per 100 pounds of whole oats, while others run as high as 75 per cent. It is very important, then, to consider the percentage of meat when testing different strains of oats. This has been determined for a large number of varieties under test during several years. It is not necessary to give these figures for all the tests. The yield per acre, average weight per bushel, percentage of meat, and yield of meat per acre, for several varieties and strains, are given in table 8.

TABLE 8. YIELD IN BUSHELS PER ACRE, AVERAGE WEIGHT PER BUSHEL, PERCENTAGE OF MEAT, AND POUNDS OF MEAT PER ACRE, FOR SEVERAL VARIETIES OF OATS UNDER TEST

Variety	Average yield per acre, 1921–1923 (bushels)	Average weight per bushel, 1921–1923 (pounds)	Per cent of meat, 1923	Average pounds of meat per acre, 1921–1923
Cornellian	57 3	32 83	75 0	1,375.2
State Sel. 133–46	56.4	31.25	72 5	1,308.5
O. A. C. No. 72	56 2	29 00	70.7	1,271.5
National Sel. 127–9	51.5	29.42	69.3	1,142.1
Jefferson County Banner	50 4	29 67	70 4	1,135.4
Comewell	49.8	28 58	70 5	1,123 5
Victory	49 6	30 25	69.8	1,107.9
Empire	49.1	30.75	70 6	1,109.3
Standwell	49 1	28 50	70.1	1,101.4
Jefferson County 343	47 4	29 58	67 5	1,023.8
Swedish Select	45 2	32.17	70.2	1,015.4
Mammoth Cluster	37 6	28 83	64.0	770.0

These results show that there is considerable variation in percentage of meat and that this does not depend absolutely on the weight per bushel. It does happen that Cornellian has the highest weight per bushel, as well as the highest percentage of meat, or kernel. The variety that has the

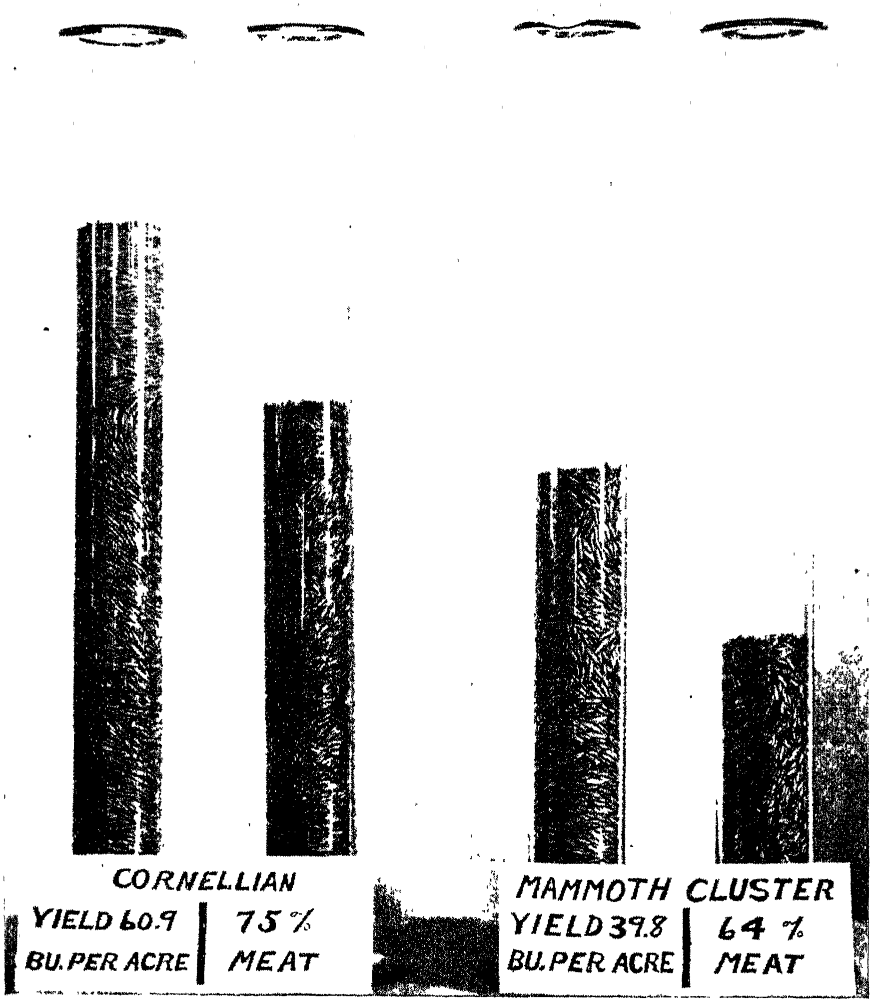

FIGURE 7. COMPARATIVE YIELDS OF OAT MEATS FROM THE VARIETIES CORNELLIAN AND MAMMOTH CLUSTER

next highest weight per bushel, Swedish Select, has a percentage of meat of only 70.2. Standwell, which has about the same percentage of meat as does Swedish Select, has a weight per bushel of only 28.50 pounds.

The importance of considering percentage of meat is shown by the column giving the pounds of meat, or kernels, per acre. The comparison of the yields of the several varieties shows a great difference when compared on the bushels-per-acre basis, and the yield of meat per acre even emphasizes this difference. The yield of whole oats in pounds per acre,

in round numbers, for Cornellian is 1834 while that for Mammoth Cluster is 1203. When these two are compared as to their production of meat per acre, it is found that Cornellian produces 1375.2 pounds while Mammoth Cluster produces only 770 pounds. Thus Mammoth Cluster is not only a poor yielder, but one that has a very low percentage of meat. In fact, Cornellian produced more pounds of oat meats per acre than Mammoth Cluster did of whole oats (figure 7).

It should be pointed out that large seeds do not always indicate a high percentage of meat. Some of the sorts with large seed are those that have thick hulls and low feeding value. The Cornellian is a small-seeded sort, yet it has a high percentage of meat due to the fact that the hull is very thin and all kernels tend to fill well. As a rule, under New York conditions the large-seeded sorts do not yield so well nor fill so well as do the medium- or smaller-seeded varieties.

RATE OF SEEDING OATS

In addition to the experiments conducted to determine the best-yielding varieties, a small test was conducted on rate of seeding. The reason for conducting such a test is that there is considerable difference in the size of seed in different varieties. Since this is true, it appears possible that if the larger-seeded varieties were sown at a heavier rate they might compare favorably in yield with the smaller-seeded sorts when sown at the ordinary rate. With this in mind, the following experiment was carried through two years. The three varieties Cornellian, Victory, and Mammoth Cluster were chosen because they represent the small-, medium-, and large-seeded types, respectively, the Cornellian being the smallest and the Mammoth Cluster the largest. The rates of seeding chosen were 1.6, 2.4, 3.2, and 4 bushels per acre. Each rate was replicated four times in the test for each year, making five comparisons for each rate of seeding. The results of this test are given in table 9.

TABLE 9. RESULTS OF RATE-OF-SEEDING TEST FOR THREE OAT VARIETIES
(Averages for two years)

Rate of seeding (bushels per acre)	Yield per acre, in bushels		
	Cornellian	Victory	Mammoth Cluster
1.6	55.2	44.0	32.2
2.4	58.5	51.5	36.7
3.2	55.9	48.7	39.3
4.0	59.0	53.2	40.9

These results show that there is a slight increase in yield for all varieties as the rate of seeding is increased from 1.6 to 2.4 bushels. When the rate is increased from 2.4 to 4 bushels per acre, there is practically no increase for Cornellian or Victory. There is, however, some increase for Mammoth Cluster. However, this variety, even when sown at the rate of 4 bushels per acre, does not yield so well as does either Cornellian or Victory sown at the rate of 1.6 bushels. The varieties Cornellian and

Victory show a slight decrease for the 3.2-bushel rate. This, however, does not seem important. The results seem to indicate that there is little to be gained in seeding more than 2½ bushels per acre for ordinary varieties. Mammoth Cluster is a poor-yielding oat, and apparently is not worth growing even when 4 bushels per acre are sown.

The results of this test, as well as the experiments conducted in other States, prove, as stated above, that probably 2½ bushels is a heavy enough rate. This rate is recommended for optimum conditions, that is, when the land has been well prepared and the seed well cleaned. If the seedbed is poorly prepared so that germination will be poor, and if the quality of seed used is inferior, a heavier rate should be used in order to obtain the best results. Certainly, for well-prepared soil and good seed, nothing will be gained in seeding more than 3 bushels. With well-cleaned seed, 8 or 9 pecks per acre for the variety Cornellian will be sufficient.

SUMMARY

The results of oat trials conducted for several years show that the selected strains are superior to the commercial varieties now on the market. The possibilities of gain through selection are shown by the results obtained from the variety National and presented in table 4. Cornellian is the outstanding variety so far as yield is concerned.

Early oats give a lower yield than do the medium-season or later oats. No early strain has been found that will average high in yield.

The side oats are not good types for New York, as shown by the results in table 6. These oats do not fill well, nor do they tiller well.

The weight per bushel of oats is available from year to year, but is not always the mark of a good variety. Because of kernel shape, some high-yielding varieties may not give a high weight per bushel.

The percentage of meat is shown to be a very important character, and there is considerable difference between varieties as to this quality. Cornellian is shown to give a very high percentage of meat, which, in addition to its yielding power, makes it a very desirable oat.

The rate-of-seeding test shows that for ordinary oats 2½ bushels per acre will be sufficient, provided the seed is well cleaned.

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Feeding Work Horses

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CONTENTS

FEEDING WORK HORSES

M. W. Harper

The feeding of the work horse is a problem of as wide interest as any other in the care and management of livestock. Most farmers, whatever the particular branch of farming in which they are engaged, have work horses to feed. Many commercial firms keep work horses, some in large numbers, and they have an interest in methods of feeding, since they must buy all supplies. Both farmers and commercial firms are especially interested in any procedure that will lessen the cost of maintaining the work horse without decreasing his usefulness.

Notwithstanding the extended use of the horse, his production and management have been subject to less experimentation than those of any other farm animal. Possibly less is known of the influence of different feeds and their combinations on horses than on any other class of farm livestock. Likewise, less attention has been given to study of the best methods of feeding and of maintaining the horse. In general, the practice is fixed by custom, by tradition, or by arbitrary rule. While the feed used and the methods employed in a given section may be the best that could be devised, possibly the occasional altering of this common practice in accordance with seasonal variation and with the variation in the price of supplies would prove not only advantageous to the animals but also more economical.

A COMPARISON OF OATS AND CORN

In this country, the two most common grains used in feeding the horse are oats and corn, and oats especially is in high repute among horsemen. It is stated that the chemical and physical composition of the oat grain is such that the horse fed oats shows a spirit that is lacking when corn is fed[1]; that oats is a better food for the work horse, especially during hot weather[2]; and that the oat is the safest of all grains for feeding the horse, since the hull gives it so much volume that the horse rarely suffers from overeating.[3] To these arguments may be added the statement that the oat contains more protein and especially more mineral matter and less carbohydrates and fat than does corn, with its high carbohydrate and fat content, and, therefore, the oat forms a more nearly balanced ration. The belief in the usefulness of the oat as a grain feed for the work horse is so strong that some persons continue to feed oats even when the price is exorbitant.

Opposed to those who favor oats are others who favor corn for the work horse. The principal statements in favor of corn are that it is extensively produced and one of the cheapest grains; that it is palatable

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Author's acknowledgments. During the progress of this work the author was ably assisted at various times by R. E. Deuel, E. S. Ham, and George Haines. E. E. Vial assisted in the compilation

[1] Gay, Carl W. Productive horse husbandry (1914), p. 325.
[2] McCampbell, C. W. Feeding work horses. Kansas State Agr. Col. Exp. Sta. Bul 186:13–70. 1912.
[3] Henry, W. A., and Morrison, F. B. Feeds and feeding (1923), p. 301.

and highly relished; that it is the great energizing food, being rich in carbohydrates and fats and, therefore, must be fed with care;[4] that corn-fed horses show as much spirit and endurance as oat-fed horses, even in hot weather;[5] and that the hard-working horse receiving corn maintains his weight on less food than if oats were fed.[6] To these arguments may be added the statement that corn is the richest of all natural grains in digestible nutrients, and, therefore, that a given amount supplies the horse with the largest amount of energy with which to perform severe work.

In view of the general interest in horse feeding, such conflicting statements, together with our limited amount of exact information regarding the economy of traditional practice, seemed of sufficient importance to warrant investigation of the facts involved.

OBJECT OF THE EXPERIMENT

The object of the experiment was to obtain information regarding the relative usefulness and economy of oats and of corn, when each was fed with timothy hay to the working horse. A number of factors were noted in the attempt to measure the relative usefulness and economy of the respective rations, such as: (1) the maintenance of weight; (2) the amount of food consumed; (3) the amount of labor performed; (4) the maintenance of health and appetite; (5) the ability to endure hard work; (6) the residual effect of the ration; and (7) the economy of maintenance.

To obtain information regarding the relative usefulness of oats and of corn as grains for the work horse, a series of tests were conducted, in which the two grains were fed in various combinations and occasionally supplemented with other concentrates, including hominy, wheat feed, wheat bran, and linseed-oil meal. A number of tests were conducted in which hominy was substituted for corn meal, since hominy is made from corn and has practically the same composition, and since hominy can often be obtained more cheaply than corn meal. The following combinations were tested:

1. Whole oats, in comparison with half ground oats and half corn meal.
2. Half whole oats and half shelled corn, in comparison with half ground oats and half corn meal.
3. Ground oats, in comparison with half ground oats and half corn meal.
4. Corn meal 9 parts and wheat bran 1 part, in comparison with half ground oats and half corn meal.
5. Ground oats, in comparison with half whole oats and half shelled corn.
6. Hominy 4 parts, wheat feed 4 parts, and linseed-oil meal 1 part, in comparison with half ground oats and half hominy.
7. Half ground oats and half hominy, in comparison with half ground oats and half corn meal.
8. Whole oats, in comparison with half whole oats and half shelled corn.

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[4] Henry, W. A., and Morrison, F. B. Feeds and feeding (1923), p. 151, 302.
[5] Carmichael, B. E. Feeding work horses. Ohio Agr. Exp. Sta. Bul. 195:244–263. 1908.
[6] Trowbridge, E. A. Corn versus oats for work mules. Missouri Agr. Exp. Sta. Bul. 114:305–325. 1913.

9. Half ground oats and half hominy, in comparison with half ground oats and half corn meal.[7]

10. Whole oats, in comparison with ground oats.

11. Half whole oats and half hominy, in comparison with half ground oats and half hominy.

PLAN OF THE INVESTIGATION

The plan of this experiment was to match the teams as nearly as possibly in weight and general endurance. Then one horse of each team was fed a basal grain ration and the other horse was fed the contrasting grain rations, both receiving the same kind and amount of hay. In general, the two horses of each team were managed and worked similarly, the object being to keep the conditions the same for both horses, except for their contrasting grain rations. Practically all of the work teams of the College were thus paired and managed, but where conditions became unequal or abnormal, the data are not included in this report.

Length of the tests

There was some variation in the lengths of the tests, depending on conditions, but as a rule each test ran six months. In one instance, where information was desired regarding the effect of the ration on a brood mare and foal, as well as on the development of the foal on such a diet, the test was conducted for twenty-nine months, though only the first six months are reported. A few tests were continued for three months.

Recuperation period

After each test was completed, a period was allowed for recuperation and to balance the teams again in general conditon. During this time, a study was made of the residual effect of the contrasting rations. The length of this period varied with the condition of the horses at the close of the test, but usually continued from one to three months. During this recuperation period, both horses of a team were fed a grain ration consisting of corn meal and ground oats mixed equal parts by weight.

The horses

This experiment was conducted with the farm horses of the New York State College of Agriculture at Cornell University. The horses were kept primarily for work, with the feeding investigation a secondary factor, the object being to make the experiment as practical as possible.

The original horses of this experiment were purchased wherever they could be obtained to advantage,— from breeders, farmers, and on the Buffalo horse market. Later, horses raised by the College were placed on test. While the teams were paired according to weight and endurance, yet there was wide variation between the several teams. Thus, there were a few purebred Percheron draft horses, a number of grade draft horses containing Percheron and Belgian blood, and a few driving horses possessing Hackney and Standardbred blood. The team of mules, Jinnie

[7] Since the conditions were different, this was not an exact duplication of test seven (page 18).

and Polly, was used in some of the tests. The Percherons were of the plainer sort and under weight. They averaged 1300 to 1600 pounds in weight, and from $15\frac{1}{2}$ to $16\frac{1}{2}$ hands in height. The grade draft horses weighed from 1100 to 1600 pounds, and stood $14\frac{3}{4}$ to $16\frac{1}{2}$ hands high. The driving horses weighed from 1000 to 1250 pounds, and ranged from 15 to 16 hands in height.

The feeds

A part of the grain used was produced on the Cornell University farms, but in the main it was purchased, from time to time and from various sources, usually in carload lots. While both oats and corn varied somewhat, they were of good average quality. In the main, the hay was produced on the university farms, though a small part was purchased locally. Throughout these tests timothy was fed, because it is the standard horse hay as well as the market hay of New York State. It varied in quality but was generally good, since New York produces timothy of high quality.

Weights and records

An account was kept of all feed given throughout the tests. The feed carrier was divided, and the contrasting grain rations were weighed for each animal at the time of feeding. The hay was weighed from the chute immediately before the evening feeding, half of it being placed in the manger and half placed aside for morning. In the tests contrasting grain rations, the uneaten hay was discarded. The weights of the horses were taken the ninth of each month, since all horses owned by the Department of Animal Husbandry are weighed on that date. A record was kept of the kind and amount of work performed, together with any unusual circumstances which occurred during the experiment.

Labor performed

In the main, the labor consisted of the team work incident to general farming during the summer and of hauling coal for the university heating plants during the winter. There was much miscellaneous work to be performed, such as grading roads and lawns about the campus; hauling ashes, garbage, and the like; delivering freight; carting express; working vegetable gardens, flower gardens, orchards, and all such work necessary to conducting the experiment station and the university farms. It should be noted that the coal hauling was often difficult, since the route lay over unimproved roads. At times these roads were almost impassable, sometimes due to mud and at other times because they froze very rough.

Daily program

The plan was to water the horses five times daily, and to feed them grain three times and hay two times each day. It was necessary to vary this plan somewhat from time to time. The following daily program was followed as closely as possible throughout the experiment, except on Sundays and holidays, when the horses were seldom worked, though it was necessary to do so at times:

Water	5.00 a. m.
Hay and grain	5.30
Groomed and harnessed	6.30
Water and to work	7.00
Stabled and watered	11.30
Grain	11.45
Water and to work	12.45 p. m.
Stabled and watered	4.45
Grain and hay	5.00
Groomed	5.30

The horses were given the refusal of water the first thing in the morning, and at times drank freely, especially during warm weather. The amount of feed given, both grain and hay, was determined by the size of the horses and by the severity of their work. The feed was given at a uniform rate, and was not varied from day to day because the horses were at fairly regular work. The contrasting grain rations were fed one-third each morning, noon, and evening, except on Saturday evenings, when all work horses received a warm bran mash, since this was thought to improve the physical condition of the horse. Hay was fed half in the morning and half in the evening. Seldom was all the hay consumed in the morning, and the remainder was available at noon. The horses were given all they would consume. To promote their comfort, as well as to improve their health, the horses were groomed in the evening after they had measurably cooled and rested from the heat and fatigue of the afternoon's work.

RESULTS OF THE INVESTIGATION

The tests comparing the relative usefulness of oats and of corn as grains for the work horse were begun November 9, 1910, and were continued to September 9, 1918, a period of seven years and ten months. During this time eleven tests were made, varying in length from three to twenty-nine months, and including a total of 176 trials, though the data for but 90 are given in this report. The most common causes for excluding data were mares in foal, mares nursing foals, and broken teams due to the necessity of shifting horses. However, these excluded data are useful in checking up on horses working under similar conditions. Indeed, the continuation in the test of these unequal teams gave many useful suggestions, and served to emphasize the difficulty of keeping all conditions comparable for any study of the effect of a specific factor.

To facilitate the presentation of the results of this investigation, a brief discussion of each test is given, and the more detailed information is arranged in tabular form in the appendix. These tables show the name, age, initial weight, gain or loss in weight, hours worked per day (after February 9, 1914), average daily food consumed per head, including grain and hay, and the average daily food consumed per 1000 pounds live weight, for both grain and hay, for each horse. The tables also include similar data for the recuperation period. In the tabulation, the horses bearing the same number composed a team. Thus, in table 1, page 43, the first team was composed of Jean and Jack, the former receiving whole oats and the latter ground oats and corn meal, mixed half and half by weight;

and so on, down the table. The grain and hay consumption per 1000 pounds live weight was calculated by averaging the monthly weights during the test.

1. *Whole oats compared with half ground oats and half corn meal*

The test of the comparative values of whole oats and of half ground oats and half corn meal was begun November 9, 1910, and was continued to April 9, 1913, a period of twenty-nine months. However, the results of but six months are included in this report, which is intended merely to contrast the two rations for the work horse. There were twenty-two comparative trials in the test, though but six are averaged and the seventh is merely tabulated in this report.

To present the general results in a concise form for contrasting a whole-oats ration with one consisting of ground oats and corn meal mixed half and half by weight, the following tabulation is given, showing the average gain or loss in weight and the average daily food consumed, of both grain and hay, per 1000 pounds live weight for both the test and the recuperation periods:

WHOLE OATS COMPARED WITH GROUND OATS AND CORN MEAL MIXED HALF AND HALF BY WEIGHT*

	Test period of six months		Recuperation period of three months	
Lot number	1	2	1	2
Grain rations of horses	Oats	½ ground oats ½ corn meal	½ ground oats ½ corn meal	½ ground oats ½ corn meal
Average gain or loss (pounds)	-38.3	+22.5	+68.1	+24.8
Grain per 1000 pounds live weight (pounds)	12.0	11.6	11.4	11.6
Hay per 1000 pounds live weight (pounds)	14.5	13.8	15.0	15.4

* For more detailed information, see table 1, page 43.

Gain or loss of weight — The horses receiving ground oats and corn meal gained, on the average, 22.5 pounds, whereas those receiving whole oats lost, on the average, 38.3 pounds, a difference of 60.8 pounds in favor of the horses receiving ground oats and corn meal. There was considerable variation in the individual weights, as shown in table 1, page 43, though Doll and Bird, that made marked gains on either ration, were engaged at light express work and for that reason are excluded from the average. Aside from this team, Signorae receiving whole oats gained 58 pounds while MacGregor lost 85 pounds. Likewise, there was wide variation among the horses receiving the contrasting ration. Thus Phillis gained 55 pounds, while MacDougal lost 35 pounds. Among the whole-oats horses, Signorae was the only one that gained weight, whereas among the horses on ground oats and corn meal, MacDougal was the only one to lose weight.

Appetite, health, and spirit — In general, the appetite of the horses was good. This was influenced to some extent by their work, which depended in part on attendant conditions, such as inclement weather and the like. Occasionally, a horse was indisposed for a meal or, in some instances, for a day or two. This was usually due to irregular work and a continuation of the experimental ration, as well as to climatic conditions. At first, apparently, the steady continuance of the various rations affected the horses at times, but the whole-oats group was the least affected. Later in the test, the whole oats were not so well relished. This may account for the apparent difference in effect on the appetite between the two rations, since the horses ate the whole oats more slowly, which no doubt resulted in a more thorough mixing of the food with the digestive juices and probably served as a protection to the appetite. The horses on ground oats and corn meal ate more rapidly, and thus showed slight indisposition during periods of irregular work.

During the test, the horses were in good health save for occasional minor ailments caused, for the most part, by exposure to inclement weather, cooling too rapidly when warm, and other irregularities difficult to avoid. When the conditions were such that irregular work resulted, the whole-oats horses had the advantage, for it was at such times that the group on ground oats and corn meal occasionally showed slight digestive disorders. On the other hand, the general physical condition of the horses on ground oats and corn meal was much better than that of the whole-oats group. This was noticeable in the long hair, the shaggy coats, and the general appearance of the whole-oats horses, of which four were out of condition while only one was so affected in the group fed ground oats and corn meal. As the test progressed, the physical condition of the whole-oats horses gradually declined, which no doubt accounts for their loss in weight.

The horses of each team were well matched in spirit and endurance, as shown by their work both before and after the test. Soon after the test began, the whole-oats horses seemed to show superior spirit. Later, such difference as was detected n ability to endure hard work was reflected by the weight, the horses that maintained their weight showing more spirit than those that steadily lost weight. In this respect the group on ground oats and corn meal had a distinct advantage. This was particularly noticeable during periods of severe work when the whole-oats group not only lost weight, but at the same time showed general impairment of their physical condition. Weight as an indication of spirit was especially noticeable in the case of Bird and Doll, for Doll, receiving whole oats, showed as much mettle as did Bird, since the work performed was light, so that both horses were able to make good gains.

Residual effects.— Since this test had been running so long — a period of twenty-nine months — three months were allowed for recuperation. Throughout this period, both horses of each team received ground oats and corn meal. During this recuperation period, it was necessary to allow some of the whole-oats horses a complete rest. This rest was given to those horses that had lost much weight during the test, such as Jean and MacGregor.

Because only six of the twenty-nine months of this test are summarized in table 1, page 43, there is a discrepancy between the weights at the close

of the test as shown in the table and at the beginning of the recuperation period. Except for Jean and Jack, this difference is not marked A comparison of the test weights with the recuperation weights in table 1 shows that the whole-oats horses recovered their original weight. As the normal weights were restored, practically all difference in spirit and endurance disappeared. As the physical condition of the whole-oats horses improved, their appetites became keener and their hair and their coats smoothed. There was little or no ill effect on any of the horses that could be traced to either ration, after their normal weights had been restored. This is especially significant, because some of the horses receiving the whole-oats ration dropped behind their team mates receiving ground oats and corn meal during the first month of the test, and did not again recover their normal weight during the entire period of twenty-nine months.

2. *Half whole oats and half shelled corn compared with half ground oats and half corn meal*

The test of the comparative values of half whole oats and half shelled corn and of half ground oats and half corn meal was begun July 9, 1913, and was continued to February 9, 1914, a period of seven months. There were eight comparative trials, though but five are averaged and a sixth merely tabulated in this report.

To present the general results in a concise form for contrasting a ration of whole oats and shelled corn with one consisting of ground oats and corn meal, the following tabulation is given, showing average gain or loss in weight and average daily food consumed, of both grain and hay, per 1000 pounds live weight, for both the test and the recuperation periods.

WHOLE OATS AND SHELLED CORN COMPARED WITH GROUND OATS AND CORN MEAL*

	Test period of seven months		Recuperation period of one month	
Lot number	3	4	3	4
Grain ration	½ oats ½ corn	½ ground oats ½ corn meal	½ ground oats ½ corn meal	½ ground oats ½ corn meal
Average gain or loss (pounds)	−38.4	+25.8	+40.0	+31.0
Grain per 1000 pounds live weight (pounds)	12.1	12.0	12.3	12.0
Hay per 1000 pounds live weight (pounds)	14.8	15.4	15.0	15.2

* For more detailed information, see table 2, page 44

Gain or loss of weight.— The hard-working horses receiving the whole grain lost an average of 38.4 pounds, whereas the horses receiving the ground grain gained an average of 25.8 pounds, amounting to a difference of 64.2 pounds in favor of the horses fed ground grain. As in the previous test, the weights of Doll and Bird are excluded from the average as shown in table 2, page 44, because this team was engaged in light express work.

Aside from this team, all horses receiving whole oats and shelled corn lost weight. On the other hand, each horse, with one exception, receiving ground oats and corn meal ga.ned weight.

Appetite, health, and spirit.— The appetite of both groups of horses was good. As in the first test, this was influenced to some extent by climatic and other conditions which resulted in various irregularities and thus occasionally caused indisposition for a meal or, in some instances, for a day or two. At first, the grinding of the grain had little direct effect on the appetite. Later in the test, the whole grains were not so well relished. As in the first test, during periods of irregular work the group on ground oats and corn meal occasionally showed indisposition, apparently due to rapid eating, whereas the horses fed whole oats and shelled corn were seldom so affected.

In general, the horses were in good health throughout the test, save for minor ailments due to irregular conditions difficult to avoid. When conditions were such as to result in irregular work, the horses on whole oats and shelled corn had the advantage, although during regular work the horses receiving ground grain showed to advantage. The general physical condition of the group on ground oats and corn meal was much better than that of the horses on whole oats and shelled corn. This was noticeable in the general appearance, the long hair, and the shaggy coats of the group fed on whole oats and shelled corn, of which three were out of condition to one so affected in the group fed on ground oats and corn meal. As the test progressed, the group fed whole oats and shelled corn continued to lose weight as well as to decline in general physical condition.

Soon after the test began, it appeared as if the horses on whole oats and shelled corn were showing the more spirit, especially during periods of irregular work, when the horses on ground oats and corn meal often showed indifference. As the test progressed, such difference as was noticeable in the spirit and in ability to endure hard work was reflected by the weight and by the general physical condition. The horses receiving ground oats and corn meal, with one exception, not only increased their weight but showed a better spirit and more endurance than did the group fed whole oats and shelled corn.

Residual effects.—At the close of this test, a period of one month was given for recuperation During this period, both horses of each team received ground oats and corn meal.

A comparison of the test weights with the recuperation weights, in table 2, page 44, shows that the horses on whole oats and shelled corn practically recovered their original weight during the recuperation period. It is significant to note that the horses made this recovery while receiving the same grain ration and while doing the same amount of work as that of the horses on ground oats and corn meal. As the normal weights were restored, all minor differences in spirit and endurance disappeared. The physical condition of the whole-grain horses improved, their hair smoothed, and there were no other ill effects that could be traced to either ration.

3. *Ground oats compared with half ground oats and half corn meal*

The test of the comparative values of ground oats and of half ground oats and half corn meal was begun March 9, 1914, and was continued to

September 9, 1914, a period of six months. There were ten comparative trials, though but five are tabulated in this report.

To present the general results in a concise form for contrasting a ground-oats ration with one consisting of ground oats and corn meal, the following tabulation is given, showing average gain or loss in weight, hours worked per day, and average daily food consumed, of both grain and hay, per 1000 pounds live weight, for both test and recuperation periods:

GROUND OATS COMPARED WITH GROUND OATS AND CORN MEAL*

	Test period of six months		Recuperation period of two months	
Lot number	5	6	5	6
Grain in ration	Ground oats	½ ground oats ½ corn meal	½ ground oats ½ corn meal	½ ground oats ½ corn meal
Average gain or loss (pounds)	−15.6	+17 4	+30 5	+23 2
Average work per day (hours)	7.8	7.4	8.4	8.1
Grain per 1000 pounds live weight (pounds).......	12.7	12 7	12.6	12 6
Hay per 1000 pounds live weight (pounds)..........	15.4	15 3	14.7	14 6

* For more detailed information, see table 3, page 45.

Gain or loss of weight.— The hard-working horses receiving ground oats lost an average of 15.6 pounds, while the horses receiving ground oats and corn meal gained an average of 17.4 pounds, amounting to a difference of 33 pounds a head in favor of the horses on ground oats and corn meal, though the horses on ground oats averaged .4 hour more work a day. There was considerable variation in the results of this test, as shown in table 3, on page 45. The variation was more marked among the horses receiving ground oats and corn meal, for Bess gained 70 pounds whereas MacGregor lost 83 pounds. Among the ground-oats horses, all, with one exception, lost weight; whereas, among the horses on ground oats and corn meal, all, with one exception, gained in weight.

Appetite, health, and spirit.— The appetite of the horses was good. As in the preceding tests, this was influenced to some extent by climatic and other conditions which resulted in various irregularities and caused occasional brief indispositions. Occasionally a horse did not relish the ground oats; whereas all were fond of the ground oats and corn meal, and their too-rapid eating of this ration sometimes brought on general indisposition during periods of irregular work. The ground oats, however, not being consumed with so great a relish, seldom produced such results. Thus, while the ground-oats group did not relish their ration so much, yet their appetites were more regular because they did not suffer the consequent indispositions.

The general health of the horses was good throughout the test, save for minor ailments due to irregular conditions, as in the preceding tests.

When the conditions were such as to result in irregular work, the ground-oats group had the advantage. On the other hand, the general physical condit on of the horses fed on ground oats and corn meal was rather better than that of the ground-oats horses, as indicated by the long hair and the shaggy coats of the ground-oats horses. of which two were out of condition to one so affected in the group fed on ground oats and corn meal.

As the test progressed, it became apparent that the spirit and ability to endure hard work was reflected in the weights and in the general physical condition. In this the horses fed ground oats and corn meal had the advantage, which was especially noticeable during periods of hard work. In this connection it should be noted that the group on ground oats and corn meal often failed to show to advantage during periods of irregular work, particularly when they showed general indifference due to too rapid eating. While the relationship between spirit and general condition was noticeable throughout this series of tests, it was further emphasized in such cases as that of MacGregor, since in this test he alone, among the horses on ground oats and corn meal, lost weight, and, likewise, he alone, in this group, showed lack of spirit and in this respect resembled the ground-oats horses.

Residual effects.— At the close of this test, a period of two months was given for recuperation. During this period both horses of each team received ground oats and corn meal.

A comparison of the test weights with the recuperation weights in table 3, page 45, shows that the ground-oats horses practically recovered their original weight during the recuperation period. It is significant to note that they made this recovery while receiving the same grain ration and while doing an additional amount, and the same kind, of work as that of the horses on ground oats and corn meal. As normal weights were restored, all minor differences in spirit and endurance disappeared. This was clearly evidenced in the case of MacGregor, who completely recovered his former spirit. As the physical condition of the ground-oats horses improved, their appetites became keen and their hair smoothed.

4. *Corn meal nine parts and wheat bran one part compared with half ground oats and half corn meal*

The test of the comparative values of nine parts corn meal and one part wheat bran and of half ground oats and half corn meal was begun November 9, 1914, and was continued to May 9, 1915. a period of six months. There were eleven comparative trials · though but five are tabulated in this report.

To present the general results in a concise form for contrasting a ration of corn meal and wheat bran with one composed of ground oats and corn meal, the tabulation on the following page is given, showing average gain or loss in weight, hours worked per day, and average daily food consumed, of both grain and hay, per 1000 pounds live weight, for both test and recuperation periods.

Gain or loss of weight.— The horses on corn meal and bran made an average loss of 5 pounds, while the horses fed ground oats and corn meal made an average gain of 16 pounds, amounting to a difference of 21 pounds a head in favor of the ground oats and corn meal, though the horses fed

CORN MEAL AND WHEAT BRAN COMPARED WITH GROUND OATS AND CORN MEAL*

	Test period of six months		Recuperation period of two months	
Lot number	7	8	7	8
Grain in ration	9 parts corn meal 1 part wheat bran	½ ground oats ½ corn meal	½ ground oats ½ corn meal	½ ground oats ½ corn meal
Average gain or loss (pounds)	-5.0	+16.0	+13 3	+21.6
Average work per day (hours)	7 8	7.6	8 4	8.4
Grain per 1000 pounds live weight (pounds)	11.9	11 0	11 9	11 9
Hay per 1000 pounds live weight (pounds)	14.1	13 4	13.7	14.6

* For more detailed information, see table 4, page 46.

corn meal and bran averaged .2 hour more work a day. There was some variation in the individual results of this test, as shown in table 4, page 46. This was due to the fact that Jean and Jack both lost weight, while each of the other horses gained or at least held his own in weight. However, on the average, the advantage of the ration of ground oats and corn meal over that of corn and wheat bran is noticeable. Every horse on ground oats and corn meal excelled its team mate on corn meal and wheat bran except Star.

Appetite, health, and spirit.— The appetite of the horses was fair. This was influenced by climatic and other conditions, which resulted in various irregularities to a greater extent than in the preceding tests. The effect on the appetite appeared to be more marked in the group on corn meal and wheat bran, while the horses on ground oats and corn meal experienced no more difficulty than usual. Thus, during periods of irregular work the horses on corn meal and wheat bran were frequently off feed for a meal, or, in some instances, for a day or two, due, no doubt, to the concentrated nature of their grain ration. It should be noted, however, that when the conditions were such as to result in regular work, no such difficulty was experienced from either ration.

In the main, the horses were in good health, although, like the appetite, the health was affected to a greater extent by irregular conditions than in the preceding tests. The appetite of the horses on corn meal and wheat bran was uncertain, and slight digestive disorders were of frequent occurrence during periods of irregular work, while the appetite of the horses on ground oats and corn meal continued about as in the preceding tests. No such disorder was experienced during regular work. The general physical condition of the two groups was much the same, though the advantage rested with the group on ground oats and corn meal, as shown in their finer hair and smoother coats. There was but one horse out of condition in each group.

The general spirit and ability to endure hard work remained very well matched as the test continued, although the advantage gradually favored the group fed on ground oats and corn meal. This was well reflected in

the weights and in the general condition of the horses. Thus, although Jack and Jean received contrasting rations and both lost in zest and mettle, Jean, receiving corn meal and wheat bran, showed more impairment than did Jack, on ground oats and corn meal. Likewise, as the test progressed, the horses on corn meal and wheat bran were more often indisposed in appetite and impaired in health, and this was reflected in their spirit and endurance, as was especially noticeable during, and for a short time following, periods of irregular work.

Residual effects.— At the close of this test, a period of two months was given for recuperation. During this period both horses of each team received ground oats and corn meal.

A comparison of the test weights with the recuperation weights, in table 4, page 46, shows that the horses on corn meal and wheat bran practically recovered their original weights during the recuperation period, though it is interesting to note that the horses on ground oats and corn meal made slightly better gains. As normal weights were restored, all minor differences in spirit and endurance disappeared. The tendency of the horses on the corn meal and wheat bran to suffer colic disappeared during their recuperation; their appetites improved, as did also their general physical condition, as indicated by the appearance of their hair and coats Their spirit and endurance became equal to that of their team mates.

5 *Ground oats compared with half shelled corn and half whole oats*

The test of the comparative values of ground oats and of half shelled corn and half whole oats was begun October 9, 1915, and was continued to January 9, 1916, a period of three months. There were, in all, fifteen comparative trials, though but six are tabulated in this report.

To present the general results in a concise form for contrasting a ground-oats ration with one consisting of oats and corn, the following tabulation is given, showing average gain or loss in weight, hours worked per day, and average daily food consumption, of both grain and hay, per 1000 pounds live weight, for both test and recuperation periods:

GROUND OATS COMPARED WITH WHOLE OATS AND SHELLED CORN*

	Test period of three months		Recuperation period of one month	
Lot number	8	9	8	9
Grain in ration	Ground oats	½ whole oats ½ shelled corn	½ ground oats ½ corn meal	½ ground oats ½ corn meal
Average gain or loss (pounds)	+2.5	−12.5	−5.0	+5.0
Average work per day (hours)	8.0	8.1	7.5	7.1
Grain per 1000 pounds live weight (pounds)	11.7	12.3	11.4	11.8
Hay per 1000 pounds live weight (pounds)	14.4	14.9	14.5	15.1

* For more detailed information, see table 5, page 47.

Gain or loss of weight.— The ground-oats horses made an average gain of 2.5 pounds, while the whole-grain horses lost 12.5 pounds, amounting to a difference of 15 pounds in favor of the horses receiving the ground oats although the whole-grain group averaged .1 hour more work a day. The difference is not especially marked in the results of this test, as shown in the complete table (table 5, page 47), though the horses receiving ground oats gave slightly better results than did those receiving shelled corn and whole oats.

Appetite, health, and spirit.— In the main, the appetite of both groups was fair, though influenced somewhat by climatic conditions. The ground oats were consumed with about the same relish as they were in test three, and the whole oats and shelled corn the same as they were in test two. Since neither of the rations in this test was so well relished as were the contrasting rations in the preceding tests, both groups of this test were more or less protected from the indifference following irregular conditions. In this test, there was little or no difference in the appetites of the two groups.

In the main, the horses were in good health except for minor ailments. While little difference was noted in their appetites, it was in connection with the general health that the ground-oats horses showed to advantage, especially following periods of irregular work and a continuance of the experimental ration, for at such times the horses on whole oats and shelled corn occasionally showed traces of digestive disorders. Likewise, the general physical condition of the ground-oats group excelled that of the group on whole oats and shelled corn. This was indicated by the long hair and by the shaggy coats of the group on whole oats and shelled corn, of which two were out of condition while none of the ground-oats horses could be said to be in poor condition in this test.

Soon after the test began, the ground-oats horses appeared to be showing the better spirit. This was probably true during periods of irregular work. Likewise, as the test continued, any difference noticeable was reflected in the weights and in the general physical condition, which was in favor of the ground-oats horses.

Residual effects.—At the close of this test, a period of one month was given for recuperation. During this period, both horses of each team received ground oats and corn meal.

A comparison of the test weights with the recuperation weights, in table 5, page 47, shows that the horses fed whole oats and shelled corn recovered much of their original weight during the recuperation period. As normal weights were restored, all minor differences in spirit and endurance disappeared, as did also the variation in general physical condition as indicated by the hair, the coat, and the general appearance.

6. *Four parts hominy, four parts wheat feed, and one part oil meal compared with half ground oats and half hominy*

The test of the comparative values of four parts hominy, four parts wheat feed, and one part oil meal, and of half ground oats and half hominy was begun February 9, 1916, and was continued to August 9, 1916, a period of six months. Because irregularities developed in a number of the teams during the last two months of the test, the data reported in the

tabulation for the first six teams cover a period of four months. There were, in all, seventeen comparative trials, though but ten are averaged and an eleventh merely tabulated in this report.

To present the general results in a concise form for contrasting a ration of hominy, wheat feed, and oil meal with one consisting of ground oats and hominy, the following tabulation is given, showing average gain or loss in weight, hours worked per day, and average daily food consumption, of both grain and hay, per 1000 pounds live weight, for the test period

HOMINY, WHEAT FEED, AND OIL MEAL, COMPARED WITH GROUND OATS AND HOMINY*

	Test period of four to six months	
Lot number	10	11
Grain in ration	4 parts hominy 4 parts wheat feed 1 part oil meal	½ hominy ½ ground oats
Average gain or loss (pounds)	+23 0	+19 0
Average work per day (hours)	7.9	7.9
Grain per 1000 pounds live weight (pounds)	12 5	12.5
Hay per 1000 pounds live weight (pounds)	14.6	15.2

* For more detailed information, see table 6, page 48.

Gain or loss of weight.— The horses receiving hominy, wheat feed, and oil meal gained 23 pounds, whereas those fed ground oats and hominy gained 19 pounds, giving an average advantage of 4 pounds in favor of the horses fed on hominy, wheat feed, and oil meal. There was considerable variation in the individual weights, as shown in table 6, page 48, though both rations produced noteworthy gains. There was variation, also, in the kind of work. Thus, Star and Stella, that made marked gains on either ration, though working long hours, were engaged in comparatively light work, and for that reason are excluded from the averages. Aside from this team, among the ground-oats-and-hominy horses, Karen gained 100 pounds while MacGregor lost 25 pounds; and among the horses on hominy, wheat feed, and oil meal, Nero gained 60 pounds and Belle 65 pounds, while MacDougal lost 15 pounds and Jean 45 pounds, during the test.

Appetite, health, and spirit.— In this test, the appetite was excellent, the animals of both groups consuming their food with relish. Apparently the wheat feed was not so well relished, but the hominy and the oil meal were sufficiently attractive to make the ration appetizing. Both rations were consumed with relish, and neither produced that indifference so often observed during periods of irregular work when feeding ground oats and corn meal as in tests one, two, three, and four. The lightness of the rations, together with the protein content and the beneficial effect of the

oil meal on the digestion, was sufficient to protect the horses from digestive disorders and from general indifference of appetite.

The horses of both groups were in good health throughout the test, and suffered very few minor ailments As would be assumed from their appetites, there was practically no difficulty following periods of irregular work. In general physical condition there was little difference between the groups, but there was a slight advantage in favor of the group on hominy, wheat feed, and oil meal, with the one exception of Jean, who was out of condition, whereas none of the ground-oats-and-hominy horses could be said to be in poor condition. Possibly the slight advantage in physical condition, as evidenced by the fine hair and the smooth coats of the horses on hominy, wheat feed, and oil meal, may have been due to the effect of the oil meal.

In spirit and general endurance the horses of each team were well matched. Such difference as was observed was reflected in their weights and in their physical condition, and in this respect the group receiving hominy wheat feed, and oil meal, with one exception, had a slight advantage. It is interesting to note that in this test the horses of both groups showed spirit during, as well as following, periods of irregular work.

7. *Half ground oats and half hominy compared with half ground oats and half corn meal*

The test of the comparative values of half ground oats and half hominy and of half ground oats and half corn meal was begun August 9, 1916, and was continued to February 9, 1917, a period of six months. There were, in all, eighteen comparative trials, though but eight are tabulated in this report.

To present the general results in a concise form for contrasting a ration of ground oats and hominy with one consisting of ground oats and corn meal, the following tabulation is given, showing average gain or loss in weight, hours worked per day, and average daily food consumption, of both grain and hay, per 1000 pounds live weight, for both test and recuperative periods:

GROUND OATS AND HOMINY COMPARED WITH GROUND OATS AND CORN MEAL*

	Test period of six months		Recuperation period of one month	
Lot number	12	13	12	13
Grain in ration	½ ground oats ½ hominy	½ ground oats ½ corn meal	½ ground oats ½ corn meal	½ ground oats ½ hominy
Average gain or loss (pounds)	+33.7	+18.7	−4.4	−2 5
Average work per day (hours)	8 1	8.0	8.4	8 1
Grain per 1000 pounds live weight (pounds)	12.6	12.5	12 9	12.8
Hay per 1000 pounds live weight (pounds)	14.3	14.2	14.3	14 2

* For more detailed information, see table 7, page 49.

Gain or loss of weight.— The horses receiving ground oats and hominy gained 33.7 pounds, whereas those fed ground oats and corn meal gained only 18.7 pounds, giving an advantage of 15.0 pounds in favor of the horses on ground oats and hominy, which also averaged .1 hour more work a day. In view of the total gain and of the work performed, this is a significant advantage, and is all the more important since, in connection with test six, it indicates that, when measured by the advantage of weight, hominy may be equal to, or even superior to, corn meal as a supplement to the grain ration of the hard-working horse. While there is considerable variation among the individual horses in the results of this test, as shown in tab e 7, page 49, yet, on the average, both rations produced noteworthy gains. Thus, among the horses on ground oats and hominy none lost weight but Stella, while Bird gained 80 pounds; and among the horses on ground oats and corn meal Nero and Nemo were the only ones that lost, whereas MacDougal gained 70 pounds.

Appetite, health, and spirit.— The appetite of the horses was good, though influenced by conditions. As in the preceding tests where ground oats and corn meal was fed, conditions resulting in various irregularities caused indispositions for a t me. As in test six, the ground-oats-and-hominy group was comparatively free from indisposition caused by irregular work. Both rations were consumed with relish during normal periods.

In the main, the animals of both groups were in good health, save for minor ailments. As would be assumed from their appetites, there was practically no difficulty following periods of irregular work for the horses on ground oats and hominy, but at such times the group fed on ground oats and corn meal occasionally showed minor digestive disorders. In this test, such disorders were slight. The general physical condition of the horses on ground oats and hominy was better than that of the horses on ground oats and corn meal. This was noticeable in the fine hair, the smooth coats, and the improved general appearances of the horses on ground oats and hominy, though the hair, the coats, and the general appearances of the group on ground oats and corn meal were very good, with the single exception of Nemo, who was out of condition. None of the horses on ground oats and hominy could be said to be in poor condition.

The spirit and the general endurance of both groups were good. As the test progressed, the spirit and the endurance were reflected in the weights and in the general physical condition, and in this the horses on ground oats and hominy had the advantage; but this was more noticeable during periods of irregular work. On the other hand, during long-continued periods of severe labor, there was little difference in the ability of the two groups to endure the work, day after day.

Residual effects.—At the close of this test, a period of one month was given for recuperation. During this period the rations of the horses of each team were exchanged, so that each horse received the ration that his team mate had received during the test.

A comparison of the test weights with the recuperation weights, in table 7, page 49, shows little variation, since the horses continued about as during the test. However, the horses on ground oats and hominy,

which had made the best gains during the test, lost slightly more than did the horses on ground oats and corn meal. The general physical condition, the appetite, the spirit, and the ability to endure hard work continued, for both groups, about as in the test proper.

8. *Whole oats compared with half whole oats and half shelled corn*

The test of the comparative values of whole oats and of half whole oats and half shelled corn was begun March 9, 1917, and was continued till September 9, 1917, a period of six months. There were, in all, fifteen comparative trials, though but nine are tabulated in this report.

To present the general results in a concise form for contrasting a whole-oats ration with one consisting of whole oats and shelled corn, the following tabulation is given, showing average gain or loss in weight, hours worked per day, and average daily food consumption, of both grain and hay, per 1000 pounds live weight, for the test period:

WHOLE OATS COMPARED WITH OATS AND CORN*

	Test period of six months	
Lot number	14	15
Grain in ration	Oats	½ oats ½ corn
Average gain or loss (pounds)	-17.2	-18.9
Average work per day (hours)	8.0	7.8
Grain per 1000 pounds live weight (pounds)	12 9	12 5
Hay per 1000 pounds live weight (pounds)	14.3	13.7

* For more detailed information, see table 8, page 50.

Gain or loss of weight.— The whole-oats horses lost 17.2 pounds, and the horses on half whole oats and half shelled corn lost 18.9 pounds, giving the whole-oats horses the advantage of 1.7 pounds, an insignificant difference. However, the important observation was that neither of these rations was sufficient to support the hard-working horse. There was considerable variation among the individuals within both groups, some gaining and others losing, as shown in table 8, page 50. This variation is more noticeable among the whole-oats horses, for MacDougal, Nemo, Jasper, and Belle lost considerably, while Signorina, Karen, Polly, and Orpha showed gains. The horses on whole oats and shelled corn showed more consistent losses, though Nix and Chloe gained in weight. The effects of the losses in both groups of horses were noticeable.

Appetite, health, and spirit.— The appetite of both groups was fair, the whole oats being consumed with about the same relish as were the whole oats in test one, and the whole oats and shelled corn with about the same relish as in tests two and five. At first, the whole-oats ration seemed to be the more appetizing, although later in the test it seemed not to be so well relished. Likewise, the appetite varied, especially in the group on whole oats and shelled corn, during periods of irregular work.

Throughout this test, the horses were in fair health, save for minor ailments. During periods of irregular work, there was a tendency for the horses on whole oats and shelled corn to have digestive disorders, though the cases were mild. As for the general physical condition, there was little difference between the groups, though both were rather deficient, as indicated by their long hair, their shaggy coats, and their generally run-down condition. Four horses in each group were out of condition.

The spirit and endurance of the horses in both groups were well matched. It was noticeable that they lost in zest and ambition as they lost in weight, and this loss was marked when the work was severe. This was especially true of MacDougal, Jasper, and Belle among the whole-oats horses and of Nero, Peter, and Bertha among the horses on whole oats and shelled corn. The general equality of effect of the two rations on the spirit was also emphasized in the case of those horses that gained steadily in weight, for they showed zest and spirit irrespective of the ration they received, especially if they maintained their general physical condition.

9. *Half ground oats and half hominy compared with half ground oats and half corn meal*

The test of the comparative values of half ground oats and half hominy and of half ground oats and half corn meal was begun September 9, 1917, and was continued to December 9, 1917, a period of three months. In reality, this test was a recuperation period; but it is treated as a test because more data were desired on the comparative value of hominy and corn meal fed in conjunction with ground oats. Since both horses of most of the teams had lost weight in the preceding test, this was thought to be an ideal opportunity to obtain such additional information. There were, in all, eighteen comparative trials, though but twelve are tabulated in this report.

To present the general results in a concise form for contrasting a ground-oats-and-hominy ration with one consisting of ground oats and corn meal, the following tabulation is given, showing average gain or loss in weight, hours worked per day, and average daily food consumption, of both grain and hay, per 1000 pounds live weight, for the test period:

GROUND OATS AND HOMINY COMPARED WITH GROUND OATS AND CORN MEAL*

	Test period of three months	
Lot number	16	17
Grain in ration	½ ground oats ½ hominy	½ ground oats ½ corn meal
Average gain or loss (pounds)	+12.1	+ 9.2
Average work per day (hours)	7 9	8.0
Grain per 1000 pounds live weight (pounds)	12.8	13.1
Hay per 1000 pounds live weight (pounds)	12.8	13.2

* For more detailed information, see table 9, page 51.

Gain or loss of weight.— The horses on ground oats and hominy gained 12.1 pounds, while the horses on ground oats and corn meal gained 9.2 pounds, showing a difference of 2.9 pounds in favor of the ground oats and hominy, a difference so small as to be without significance. In view of the kind of work performed, it is noteworthy that, on the average, the horses of both groups were able to make gains. Since the contrasting rations gave such slightly differing results, as shown in table 9, page 51, the average of the first seven teams favors the ground oats and corn meal. There was considerable individual variation in both groups. Thus, among the horses fed ground oats and hominy, Karen lost heavily, but Nero, on the ground-oats-and-corn-meal ration, gained as heavily.

Appetite, health, and spirit.— In the main, the appetite of the horses was very good, the ground oats and hominy being consumed with about the same relish as in tests six and seven, and the ground oats and corn meal were as much relished as in the previous test. In fact, the effect on the appetite of the contrasting rations in this test was similar to that in test seven, but with one difference. This test came in the fall of the year, when there was a considerable amount of hard work to be done, which kept the appetites keen; and this protected the horses from the indisposition that accompanies irregular work. This probably was advantageous to the group on ground oats and corn meal, through maintaining their appetite.

In general, the horses of both groups were in good health. Here again, results were much as in test seven, except that the animals of both groups were subjected to a greater strain. This, in a way, had a beneficial effect, since it served to keep them free from the sluggishness that ordinarily resulted from periods of irregular work, and hence neither group suffered from this cause. While the physical condition of the team mates was similar, the horses on ground oats and hominy had some advantage, as was reflected in their weights, as well as in their hair, in their coats, and in their general appearance. There were two horses out of condition in the ground-oats-and-corn-meal group to one in the ground-oats-and-hominy group.

In the main, the spirit and the general endurance of both groups were good. In this respect the results were much as in test seven, for in the beginning of the test it seemed that first one group and then the other was showing the better spirit. However, as the test continued, the spirit and the endurance were reflected in the weights and in the general physical condition; and in these respects the group on ground oats and hominy had a slight advantage, though much less marked than in test seven.

10. *Whole oats compared with ground oats*

The test of the comparative values of whole oats and of ground oats was begun December 9, 1917, and was continued to March 9, 1918, a period of three months. There were eighteen comparative trials, though but eleven are included in this report.

To present the general results in a concise form for contrasting a whole-oats ration with one consisting of ground oats, the following tabulation is given, showing average gain or loss in weight, hours worked per day,

and average daily food consumption, of both grain and hay, per 1000 pounds live weight, for the test period:

WHOLE OATS COMPARED WITH GROUND OATS*

	Test period of three months	
Lot number	18	19
Grain in ration	Oats	Ground oats
Average gain or loss (pounds)	+ 2.7	+ 9.5
Average work per day (hours)	8.4	8.5
Grain per 1000 pounds live weight (pounds)	12.8	12.6
Hay per 1000 pounds live weight (pounds)	12.8	12.7

* For more detailed information, see table 10, page 52

Gain or loss of weight.— The whole-oats horses gained 2.7 pounds and the ground-oats horses 9.5 pounds, an advantage of 6.8 pounds in favor of the ground-oats horses. In this test, the weights continued uniform, as shown in table 10, page 52, though there was variation among the individual horses on both rations. Thus among the whole-oats horses seven gained and four lost weight, while among the ground-oats horses five gained, four lost weight, and two remained the same.

Appetite, health, and spirit.— The appetite of both groups of horses was fair, the whole oats being consumed with about the same relish as in tests one and eight, and the ground oats the same as in tests three and five. Although the appetite was influenced to some extent by the work, it is significant that there was less disturbance for this cause in this test than in any other in the experiment. Between the groups there was little or no difference in the appetite, though among the individual horses some appeared to prefer the ground oats while others were more fond of the whole grains.

The horses of both groups were in good health, save for minor ailments. As the appetite would indicate, they were less subject to ailments resulting from irregular work than in any other test of the experiment. This was due in part, no doubt, to their method of eating. In this respect, there was little difference between the two groups. The general physical condition of the two groups compared favorably, with the ground-oats group showing a slight advantage. True, both groups showed impairment in physical condition, as indicated by their long hair, their shaggy-coats, and their general indifference. Two horses were out of condition in the whole-oats group to one so affected in the ground-oats group.

Throughout this test, the spirit and the general endurance of both groups were fair. There was little difference between the groups, and this was reflected in the weight and in the general physical condition, which slightly favored the ground-oats horses. As the appetite and the general health would indicate, both groups of this test were free from those depressions in spirit so frequently observed during periods of irregular work in

the other tests of this experiment in which a more concentrated grain ration was fed. However, it is also true that when the horses were on the more concentrated grain rations of the other tests they showed more zest and spirit during normal conditions than they did in either group of this test.

11. *Half whole oats and half hominy compared with half ground oats and half hominy*

The test of the comparative values of half whole oats and half hominy and half ground oats and half hominy was begun March 9, 1918, and was continued to September 8, 1918, a period of six months. There were, in all, twenty-four comparative tests, though but ten are included in this report.

To present the general results in a concise form for contrasting a ration of whole oats and hominy with one consisting of ground oats and hominy, the following tabulation is given, showing average gain or loss in weight, hours worked per day, and average daily food consumption, of both grain and hay, per 1000 pounds live weight, for the test period:

WHOLE OATS AND HOMINY COMPARED WITH GROUND OATS AND HOMINY*

	Test period of six months	
Lot number	20	21
Grain in ration	½ oats ½ hominy	½ ground oats ½ hominy
Average gain or loss (pounds)	+19.5	+40.5
Average work per day (hours)	8.2	8 2
Grain per 1000 pounds live weight (pounds)	12.7	12.5
Hay per 1000 pounds live weight (pounds)	13.1	12.9

* For more detailed information, see table 11, page 53

Gain or loss of weight.— In general, either ration gave good results, the horses on whole oats and hominy gaining 19.5 pounds, while the horses on ground oats and hominy gained 40.5 pounds, giving an advantage of 21 pounds to the horses on ground oats and hominy. This test closed in the early fall, during a rather slack work season, which probably accounts, in part, for the rather good gains made by both groups of horses. The results of this test vary widely, as shown in table 11, page 53. This variation is especially noticeable among the horses on whole oats and hominy, of which Topsy gained 55 pounds while Nero and Polly lost 15 pounds each; while among the horses on the ground oats and hominy Nix gained 65 pounds while Jinnie failed to gain.

Appetite, health, and spirit.— The appetite of both groups was excellent, the ground oats and hominy being relished as in the preceding tests, while the whole oats and hominy seemed to be only slightly less appetizing. This was influenced to some extent by the work, since, after a day or two

of irregular work, an occasional horse might be indifferent about his grain. Nevertheless, considering the rather light work of this period, together with the relish with which both rations were consumed, the appetites remained exceptionally uniform.

The horses of both groups were in good health throughout the test, save for minor ailments. Considering the amount of grain fed and the rather irregular nature of the work, both groups were comparatively free from those minor ills so noticeable under such conditions with concentrated grain rations. Likewise, both groups were in good physical condition, their hair being fine and their coats smooth. In this respect, the group on ground oats and hominy had the advantage. There were no horses in either group that could be said to be in poor condition.

The spirit and the endurance of the horses were good, though a condition appeared in this test which had not been observed in the preceding tests. Hitherto, the spirit had been reflected in the weight and in the general physical condition; and within limits such was also the case in this test, particularly with the animals that made small gains, as well as with those that, as they lost weight, showed the effect in their declining spirit. In this test, however, there was also a lack of zest and endurance in those animals that took on fat. This was especially noticeable during the last two months of the test.

SUMMARY OF RESULTS

Relationship of rations to gain or loss in weight

Because of the various combinations and conditions in which oats and corn were fed, a general review of the results is significant. In this series of tests the results varied widely, even with the same ration. A review of the literature contrasting these grains likewise reveals conflicting data. A study of the results obtained, in connection with the attendant conditions in the several tests of this experiment, may aid in an explanation of the lack of uniformity in the results obtained, as well as that noted in a review of the experimental literature. Indeed, an explanation of such conflicting data often may be found in the attendant conditions under which the experiment was conducted. Thus, if the work were irregular in amount, or even in kind, though including considerable moderate work, the results obtained from comparing such grains would probably vary from those of a similar test involving regular and severe work. To illustrate such variations in results, a summary of the eleven tests herein reported is included in the tabulation on page 26, giving the rations used and the average gain or loss, together with the contrasting ration, for each of the tests, also including gain or loss. The table gives the number of the test and the number of horses in each test, as well as the number of horses out of condition in each test. To emphasize the agreement in the results obtained, as well as to indicate more clearly the lack of uniformity where such exists, the tabulation is so arranged as to show results obtained from each ration, as well as those from each contrasting ration.

A review of this tabulation shows general agreement, in that ground oats and corn meal gave better results than whole oats in test one, than whole oats and shelled corn in test two, than ground oats in test three, and than corn meal and wheat bran in test four. But the results obtained

RELATIONSHIP OF RATIONS TO GAIN OR LOSS IN WEIGHT

Test number	Number of teams in test	Test ration: Gain or loss (pounds)	Test ration: Number in poor condition	Contrasting ration: Kinds of grain	Contrasting ration: Gain or loss (pounds)	Contrasting ration: Number in poor condition
		Ground oats and corn meal				
1	6	+22.5	1	Whole oats	-38.3	4
2	5	+25 8	1	Whole oats and shelled corn	-38 4	3
3	5	+17 4	1	Ground oats	-15 6	2
4	5	+16 0	1	Corn meal 9 parts, wheat bran 1 part	- 5.0	1
7	8	+18 7	1	Ground oats and hominy	+33.7	0
9	12	+ 9 2	2	Ground oats and hominy	+12 1	1
Total	41	...	7			
Average	.	+16 9	.			
		Ground oats and hominy				
6	10	+19 0	0	Hominy, wheat feed, and oil meal	+23 0	1
7	8	+33 7	0	Ground oats and corn meal	+18 7	1
9	12	+12 1	1	Ground oats and corn meal	+ 9 2	2
11	10	+40 5	0	Whole oats and hominy	+19.5	0
Total	40	...	1			
Average	...	+25.2	...			
		Whole oats and shelled corn				
2	5	-38 4	3	Ground oats and corn meal	+25 8	1
5	6	-12.5	2	Ground oats	+ 2.5	0
8	9	-18.9	4	Whole oats	-17 2	4
Total	20	.....	9			
Average	.	-21 8	...			
		Whole oats and hominy				
11	10	+19.5	0	Ground oats and hominy	+40 5	0
		Hominy 4 parts, wheat feed 4 parts, and oil meal 1 part				
6	10	+23 0	1	Ground oats and hominy	+19 0	0
		Corn meal 9 parts, and wheat bran 1 part				
4	5	- 5.0	1	Ground oats and corn meal	+16.0	1
		Whole oats				
1	6	-38.3	4	Ground oats and corn meal	+22.5	1
8	9	-17.2	4	Whole oats and shelled corn	-18 9	4
10	11	+ 2.7	2	Ground oats	+ 9.5	1
Total	26	....	10			
Average	......	-13 6	....			
		Ground oats				
3	5	-15.6	2	Ground oats and corn meal	+17.4	1
5	6	+ 2.5	0	Whole oats and shelled corn	-12.5	2
10	11	+ 9.5	1	Whole oats	+ 2.7	2
Total	22	....	3			
Average	......	+ 1.9	......			

were not so advantageous for ground oats and corn meal when compared with the results from ground oats and hominy as in tests seven and nine, though the difference is not marked in test nine. Ground oats and hominy also excelled whole oats and hominy in test eleven; but the results were not so satisfactory for ground oats and hominy when compared with those of hominy, wheat feed, and oil meal in test six. There was general agreement, in that whole oats and shelled corn gave results inferior to those of ground oats and corn meal in test two, to those of ground oats in test five, and to those of whole oats in test eight. There is also agreement in that ground oats gave better results than whole oats and shelled corn in test five, and better than whole oats in test ten.

While there is agreement in that ground oats and corn meal produced gains in each of the six tests, yet there is a lack of uniformity in the results, which range from an average gain of 25.8 pounds in test two to 9.2 pounds in test nine. There is general agreement in that ground oats and hominy produced gains in each of the four tests, yet there is a lack of uniformity in the results, which range from 40.5 pounds in test eleven to 12.1 pounds in test nine; and when ground oats and hominy in test nine are compared with either ground oats and corn meal in test seven or whole oats and hominy in test eleven, the results are not favorable to ground oats and hominy. While there is agreement in that whole oats and shelled corn produced losses in each of the three tests, yet there is lack of uniformity in the results, which range from an average loss of 38.4 pounds in test two to a loss of 12.5 pounds in test five; and when whole oats and shelled corn in test five are compared with whole oats in test eight, the results are in favor of whole oats and shelled corn. There is a lack of agreement in the results obtained with whole oats which range from an average loss of 38.3 pounds in test one to a gain of 2.7 pounds in test ten. Likewise, there is a lack of agreement in the results obtained with ground oats, which range from an average loss of 15.6 pounds in test three to a gain of 9.5 pounds in test ten; and when the results of ground oats in test three are compared with those of either whole oats and shelled corn in test five or with those of whole oats in test ten, the results are favorable to the contrasting ration.

Much of this iregularity is due to attendant conditions, and, in the main, to the kind and amount of work performed. Thus, in the case of the small gain of 9.2 pounds among the horses on ground oats and corn meal in test nine, the work was much more severe than in many of the other tests where the same ration was fed. This also accounts for the comparatively small gains in the horses on ground oats and hominy in test nine, as compared with the same ration in test seven and also especially in test eleven, where the work was moderate. If the test included considerable moderate work, a comparatively bulky or light ration, such as oats, either whole or ground, gave good results, whereas, if the work included was regular and severe, a heavy, nutritious ration, such as one containing a goodly proportion of corn meal or hominy, was essential to protect the horses against loss in weight. While many of these observations do not apply in contrasting rations in any given test, yet too much emphasis cannot be put on the importance of numerous trials, under varying conditions, in contrasting the usefulness of such grains in a ration for the work horse.

Another fact which accounts for much of the irregularity in results obtained was the difference in individuality among the horses. This was a constantly disturbing factor, especially during the early tests. Later, the individual differences became fairly well known, and the teams were mated so as to offset this factor, or, at least, to reduce its effect. Where experiments are of short duration, this factor may offset the advantage of almost any ration, especially if the animals contrasted are few in number. However, where the horses are under continuous observation from colthood throughout life, error from this source is reduced to a minimum.

Relationship of rations to appetite

Since corn and oats are among the most palatable feeds, each of these grains was readily consumed. True, there was variation among the rations in this respect. It appeared as if the rations that were most relished under normal conditions were the very ones that affected the appetite adversely under irregular conditions. Probably such rations were consumed too rapdily, thus resulting in incomplete mastication and salivation, which, during periods of irregular work, often brought on slight digestive disorders that affected the appetite. This was most noticeable in the case of those rations containing corn, especially meal, and to some extent in those containing hominy. These concentrated feeds varied in this respect, some batches tending to cause trouble, while other batches produced no such adverse effect.

Aside from the irregular work resulting from inclement weather, the general climatic conditions had a marked influence on the appetite. Thus, during clear, crisp weather the appetite of the horses was much keener than during muggy, depressing weather.

On the other hand, it appeared that some of the rations were less relished and hence were consumed more slowly. This slower eating no doubt aided in mastication and in mixing the food well with the digestive juices, and thus favored digestion and had many other advantages, among which were protecting the appetite of the horses and freeing them from digestive as well as other attendant disorders. Slower eating was noticeable with rations containing large amounts of oats, either whole or ground, and with some of the rations containing hominy. In this connection it is significant to note that the long-continued feeding of some of these rations apparently resulted in the animals losing relish. Sometimes this was more noticeable with whole grains, especially oats, and at other times with ground oats. As in the more concentrated rations, possibly the oats varied in this respect, so that some batches affected the horses more than others.

No doubt the composition of the ration affected the appetite, since those rations containing materials aiding digestion, such as increased protein and fat in the case of oil meal and hominy, were more readily consumed. Moreover, because of their stimulation of the digestion, they seldom resulted in physical impairment which would be reflected in the impaired appetite.

Relationship of rations to feed consumed

Some of the horses appeared to prefer the ground grains, whereas others relished best the entire kernels; some appeared to prefer the mixtures,

whereas others relished the single-grain rations; some preferred oats, others corn; but all relished the warm bran mash given on Saturday evenings. To present the food consumption in concrete form, the following tabulation is arranged, giving the average consumption per 1000 pounds live weight for each of the rations, together with the gain or loss produced by each ration.

FEED PER 1000 POUNDS LIVE WEIGHT

Test number	Ration	Grain (pounds)	Hay (pounds)	Total (pounds)	Gain or loss (pounds)
1	Whole oats	12.0	14.5	26.5	-38.3
	Half ground oats, half corn meal	11.6	13.8	25.4	+22.5
2	Half whole oats, half shelled corn	12.1	14.8	26.9	-38.4
	Half ground oats, half corn meal	12.0	15.4	27.4	+25.8
3	Ground oats	12.7	15.4	28.1	-15.6
	Half ground oats, half corn meal	12.7	15.3	28.0	+17.4
4	Corn meal 9 parts, wheat bran 1 part	11.9	14.1	26.0	-5.0
	Half ground oats, half corn meal	11.0	13.4	24.4	+16.0
5	Ground oats	11.7	14.4	26.1	+2.5
	Half whole oats, half shelled corn	12.3	14.9	27.2	-12.5
6	Hominy 4 parts, wheat feed 4 parts, oil meal 1 part	12.5	14.6	27.1	+23.0
	Half hominy, half ground oats	12.5	15.2	27.7	+19.0
7	Half ground oats, half hominy	12.6	14.3	26.9	+33.7
	Half ground oats, half corn meal	12.5	14.2	26.7	+18.7
8	Whole oats	12.9	14.3	27.2	-17.2
	Half whole oats, half shelled corn	12.5	13.7	26.2	-18.9
9	Half ground oats, half hominy	12.8	12.8	25.6	+12.1
	Half ground oats, half corn meal	13.1	13.2	26.3	+9.2
10	Whole oats	12.8	12.8	25.6	+2.7
	Ground oats	12.6	12.7	25.3	+9.5
11	Half whole oats, half hominy	12.7	13.1	25.8	+19.5
	Half ground oats, half hominy	12.5	12.9	25.4	+40.5

There was little difference in the consumption of the several rations. The highest grain consumption per 1000 pounds live weight was 13.1 pounds for ground oats and corn meal, in test nine; and the lowest grain consumption was 11.0 for ground oats and corn meal, in test four. The highest hay consumption was 15.4 pounds with the ground-oats-and-corn-meal ration, in test two, and with the ground-oats ration, in test three; and the lowest hay consumption was 12.7 pounds with the ground-oats ration, in test ten. It should be recalled that uneaten hay was not deducted. The lowest total food consumption was 24.4 pounds for ground oats and corn meal, in test four; and the highest total food con-

sumption was 28.1 pounds for ground oats, in test three. The ground oats and corn meal produced a rather substantial gain, and the ground oats a notable loss. To identify the consumption more clearly with the ration, the following tabulation is given, showing the consumption for each grain ration per 1000 pounds live weight, together with the resulting gain or loss in weight, without regard to that with which it was contrasted.

FOOD CONSUMED PER 1000 POUNDS LIVE WEIGHT, AND GAIN OR LOSS IN WEIGHT

Test number	Number of teams	Grain (pounds)	Hay (pounds)	Total (pounds)	Gain or loss (pounds)
Half ground oats, half corn meal					
1	6	11.6	13.8	25.4	+22.5
2	5	12.0	15.4	27.4	+25.8
3	5	12.7	15.3	28.0	+17.4
4	5	11.0	13.4	24.4	+16.0
7	8	12.5	14.2	26.7	+18.7
9	12	13.1	13.2	26.3	+ 9.2
Total	41				
Average		12.3	14.0	26.4	+16.9
Half ground oats, half hominy					
6	10	12.5	15.2	27.7	+19.0
7	8	12.6	14.3	26.9	+33.7
9	12	12.8	12.8	25.6	+12.1
11	10	12.5	12.9	25.4	+40.5
Total	40				
Average		12.6	13.7	26.3	+25.2
Half whole oats, half shelled corn					
2	5	12.1	14.8	26.9	-38.4
5	6	12.3	14.9	27.2	-12.5
8	9	12.5	13.7	26.2	-18.9
Total	20				
Average		12.3	14.3	26.7	-21.8
Half whole oats, half hominy					
11	10	12.7	13.1	25.8	+19.5
Hominy four parts, wheat feed four parts, oil meal one part					
6	10	12.5	14.6	27.1	+23.0
Corn meal nine parts, wheat bran one part					
4	5	11.9	14.1	26.0	- 5.0

FOOD CONSUMED PER 1000 POUNDS LIVE WEIGHT, AND GAIN OR LOSS IN WEIGHT (*cont*)

Test number	Number of teams	Grain (pounds)	Hay (pounds)	Total (pounds)	Gain or loss (pounds)
		Whole oats			
1	6	12 0	14 5	26 5	−38.3
8	9	12 9	14 3	27 2	−17 2
10	11	12 8	12 8	25 6	+ 2 7
Total	26				
Average		12 6	13 7	26 4	−13 6
		Ground oats			
3	5	12 7	15.4	28 1	−15 6
5	6	11 7	14 4	26 1	+ 2 5
10	11	12 6	12 7	25 3	+ 9 5
Total	22				
Average		12 4	13 8	26 2	+ 1 9
Average of all		12 4	13 9	26 4	

This tabulation shows remarkable uniformity in food consumption, especially since the amounts are based on live weight. However, there is little relation between the food consumption and the gain or loss in weight, since the largest gain, 40.5 pounds for ground oats and hominy, in test eleven, was made on 25.4 pounds food consumption, which is next to the smallest; while the highest food consumption, 28.1 pounds for ground oats, in test three, resulted in a loss of 15.6 pounds.

Economy of the rations

The relative economy of these contrasting grain rations depends, in the main, on the relative price of oats and corn. Oats are usually comparatively high in price, which is especially noticeable when the cost is considered on the basis of the digestible nutrients contained in the grains. The several tests in this experiment indicate that it would be economical to substitute corn for oats, at least in part, when oats are comparatively high in price.

The cost of the horse's ration is a much-discussed question. Estimates vary widely, the main complication being the cost of the feed used in the calculation. Sometimes the cost of the ration is estimated by considering the feed at the market value; sometimes the cost is based on an estimated value of the feed on the farm; and sometimes the cost is calculated according to the estimated cost of producing the feed on the farm. These three methods often give widely different results. The price of feed is very unstable, and costs calculated for any given time may not apply even approximately a few days later. During the period covered by this experiment the price of feed fluctuated through a wide range, shelled corn being quoted at $16 a ton in the spring of 1911 and at $85 a ton in the

fall of 1917; oats at $18 a ton in the spring of 1911 and at $65 a ton in the spring of 1918; while timothy hay varied from $10 to $45 a ton during the period. In calculating the cost of feeding a horse, it is suggested that each person interested consider the factors involved and then compute the probable cost according to the attendant conditions.

Relationship of rations to health

In the main, the horses were in good health throughout the several tests. They consumed their rations and were ready for their daily work, save for occasional minor ailments brought on by irregular work and a continuation of the experimental rations.

During periods of irregular work, the management of the horses receiving the more concentrated and heavier rations called for considerable skill because occasionally they were threatened with azoturia when put to work after standing in the stable a day or two. This was especially true in the tests where corn meal was used and to some extent in the hominy groups. No doubt the weekly use of the bran mash did much to protect the animals from this ailment, which is common in hard-working and well-fed horses that, because of inclement weather or for other reasons, have remained idle a day or two. This ailment was more troublesome in late fall, winter, and early spring.

Although as a rule the horses were in good physical condition, there was considerable difference among the groups in this respect. Those in poor physical condition were not the ones that showed irregularity in health due to the grain ration. Indeed, those receiving the more bulky ration, and which suffered least from their method of eating, were more often out of condition, as shown by their thick hair, their rough coats, their impaired appearance, and their loss of weight. Thus, about 45 per cent of the horses fed whole oats and shelled corn, 38 per cent of the whole-oats horses, 17 per cent of the horses fed ground oats and corn meal, and 13 per cent of the ground-oats horses, as compared with 2 per cent of the horses fed ground oats and hominy, were out of condition at some time during the tests.

Relationship of rations to spirit

In general, the horses were in good spirits throughout the several tests, going to their work with zest and continuing so throughout the day. Of course, there were individual differences among the horses in this respect; but nevertheless the rations, together with attendant conditions, had their influence on the spirit and on the general endurance. As a rule, the animals that were not in good condition showed poor spirit. Since those animals that were in poor condition were also losing weight, it naturally appeared as if there were a relationship between loss of weight and lack of spirit and of endurance. On the other hand, in reviewing the individual tests, frequent reference has been made to the fact that, for a time at least, the oats-fed horses apparently showed better spirit, though steadily losing weight, than did the horses receiving part corn or hominy.

It was noticed that during continuous hard work those horses receiving the more concentrated ration showed the more endurance, while during periods of slack work those horses receiving the more bulky ration apparently showed better spirit. This peculiar condition depended on the effect

of the rations on the health. Thus the ration that had a tendency to produce digestive disorders resulted in depressing the spirit, especially while the horse was suffering from indigestion. During periods of severe work, digestion was normal and the ration, being nutritious, supplied the needed energy and produced a spirit lacking in the more bulky and less nutritious ration. On the other hand, during periods of irregular work, this same bulky ration supplied the nutrients for sufficient energy, and, since it did not depress the appetite, produced a superior spirit, whereas the nutritious ration depressed the spirit.

While there was a general relationship between the spirit and the endurance on the one hand and the weight and the physical condition on the other, it is significant to note the important exception shown in test eleven. Thus, if the work and the feed were such as to permit the horse to accumulate fat to an appreciable extent, it affected his endurance and impaired his general spirit.

CONCLUSION

Horses receiving ground oats and corn meal excelled, in weight, in spirit, in endurance, and in physical condition, their team mates receiving whole oats, in test one; those receiving whole oats and shelled corn, in test two; those receiving ground oats, in test three; and those receiving corn meal and wheat bran, in test four.

Horses receiving ground oats and hominy excelled, in weight, in spirit, in endurance, and in physical condition, their team mates receiving ground oats and corn meal, in tests seven and nine; and their team mates receiving whole oats and hominy, in test eleven.

Horses receiving ground oats excelled, in weight, in spirit, and in physical condition, their team mates receiving whole oats and shelled corn in test five; and their team mates receiving whole oats, in test ten.

Horses receiving hominy, wheat feed, and oil meal excelled their team mates receiving ground oats and hominy, in weight, though the horses on ground oats and hominy showed as much spirit and endurance, and even excelled in physical condition, in test six.

Horses receiving whole oats were about equal, in weight, in spirit, in endurance, and in physical condition, to their team mates receiving whole oats and shelled corn, in test eight.

Horses receiving ground oats mixed with either corn meal or hominy maintained their thrift and gained in weight, while those receiving ground oats were scarcely able to maintain their condition.

Horses receiving whole oats or whole oats and shelled corn were unable to retain their thrift, and steadily lost in weight when engaged in severe work.

Horses receiving the same ration showed widely varying results. Thus, ground oats and corn meal produced a gain of 25.8 pounds in test two and of only 9.2 pounds in test nine. The gain from ground oats and hominy varied from 12.1 pounds in test nine to 40.5 pounds in test eleven. The loss from whole oats and shelled corn varied from 12.5 pounds in test five to 38.4 pounds in test two. The results from whole oats varied from a gain of 2.7 pounds in test ten to a loss of 38.3 pounds in test one. The results from ground oats varied from a gain of 9.5 pounds in test ten to a loss of 15.6 pounds in test three. Such variations were due largely to

varying conditions, and in the main to the kind and amount of work performed.

When the work was light or irregular in amount, oats, either whole or ground, gave good results; but when the work was severe and regular, continuing day after day, the addition of hominy or corn meal to the ration gave much better results.

At the usual price of feed, it was economical to add either hominy or corn meal to the ration of the hard-working horse.

PROPORTION OF GRAIN TO HAY

There is wide variation between grain and hay as sources of nutrients for the horse. Grain is concentrated, palatable, digestible, and nutritious. Hay is bulky, containing large amounts of crude fiber, and is comparatively low in digestible nutrients. It is relatively abundant on most farms and is, therefore, cheaper than grain, which accounts for the tendency to feed it to excess. Continuous overfeeding of bulky roughage is detrimental, because it may distend the abdomen, which interferes with the animal's usefulness. There is also the possibility of inducing digestive disorders, such as colic, impaction, heaves, and other diseases.[8]

OBJECT OF THE EXPERIMENT

The object of this experiment was to obtain information regarding the amount of hay that may be fed to the work horse with safety and without limiting the animal's efficiency.

PLAN OF THE EXPERIMENT

The plan of this experiment was similar to that of the preceding experiment, but the ration, the method of taking the weights, and the length of the tests, which were for shorter periods, varied. Two tests, each of which consisted of two periods, were made.

The rations

One horse of each team was fed the regular ration consisting of oats and corn, ground and mixed half and half by weight, together with timothy hay. Saturday evenings all work horses received a warm bran mash.

During the first test, the other horse of each team was fed two-thirds of the regular grain ration with the amount of hay increased so that the total nutrients were the same as in the regular ration. This ration is designated the "maximum-hay ration." Thus, the regular ration consisted of 18 pounds of grain and 18 pounds of hay for the heavy teams, and of 15 pounds of grain and 16 pounds of hay for the light teams. The maximum-hay ration consisted of 12 pounds of grain and 27 pounds of hay for the heavy teams, and of 10 pounds of grain and 23½ pounds of hay for the light horses.

During the second test, the maximum-hay ration consisted of three-quarters as much grain as in the regular ration, with the hay increased so that the total nutrients were the same as in the regular ration. The regular ration was the same as before, but the maximum-hay ration consisted of 15 pounds of grain and 23 pounds of hay for the heavy horses, and of 12 pounds of grain and 21 pounds of hay for the light animals.

[8] Henry, W. A. and Morrison, F. B. Feeds and feeding (1923), p. 310.

Weights and records

To get the initial and final weights, the horses were weighed for three successive days and these weights were averaged. The tests were begun as of the middle date. In addition, the animals were weighed each week. An accurate account was kept of all feeds consumed. The uneaten hay was weighed, and this amount was deducted from the amount fed.

RESULTS OF THE INVESTIGATION

In this experiment and in the two following, all of the horses used in the tests, with one exception, are reported in the results. The shorter periods of these tests made it possible to pair the horses more uniformly in teams so that differences serious enough to cause teams to be discarded seldom arose. Since short periods do not give conclusive results, the tests were repeated. In addition, the tests were divided into two periods and the rations were shifted.

12. *The normal ration compared with a ration of minimum grain and maximum hay*

The first test was begun March 27, 1920, and was continued to May 22, when the rations were shifted so that the check horses became the test horses and the test horses became the check horses, and then the test was continued until July 17, thus covering in all a period of 112 days. The second test was begun December 23, 1920, and was continued to February 10, 1921, when the rations were shifted; the test was continued to March 31, a period of 100 days. This method should show the ill effects, if any, of the large hay ration, and should also demonstrate the recovery of the horses when placed on the regular ration.

To present the general results in a concise form for comparing a regular ration with one composed of a minimum amount of grain and a maximum amount of hay, the following tabulation is given, showing the average of the more essential factors for both tests.

NORMAL RATION COMPARED WITH A RATION OF MINIMUM GRAIN AND MAXIMUM HAY*

Kind of ration	First test		Second test	
	Regular	⅔ grain maximum hay	Regular	¾ grain maximum hay
Average gain or loss (pounds)	+9.0	−12.5	+22.2	−5.5
Average work per day (hours)	7.8	7.8	8.1	8.1
Grain per 1000 pounds live weight (pounds)	12.4	8.4	13.1	10.9
Hay per 1000 pounds live weight (pounds)	12.4	17.6	12.5	15.8
Digestible nutrients in grain (pounds)	9.37	6.30	9.90	8.25
Digestible nutrients in hay (pounds)	6.02	8.55	6.05	7.64
Total digestible nutrients (pounds)	15.38	14.86	15.95	15.89
Average grain per head (pounds)	16.1	10.9	17.3	14.5
Average hay per head (pounds)	16.1	23.0	16.6	20.9
Average cost, with grain $28 and hay $12 a ton (cents)	32.2	29.1	34.2	32.8
Average cost, with grain $56 and hay $12 a ton (cents)	54.8	44.3	58.4	53.1
Average cost, with grain $56 and hay $24 a ton (cents)	64.4	58.1	68.3	65.7
Saving, with grain $28 and hay $12 a ton (cents)	.	3.1	.....	1.4
Saving, with grain $56 and hay $12 a ton (cents)	...	10.5	.....	5.3
Saving, with grain $56 and hay $24 a ton (cents)	.....	6.3	....	2.6

* For more detailed information, see table 12, pages 54–57.

Gain or loss of weight — The results favor the horses receiving the regular ration, each group showing a gain ranging from 9.0 pounds in test one, where the two-thirds grain ration was fed, to 22.2 pounds in test two, where the three-fourths grain ration was used. On the other hand both groups of the maximum-hay horses lost, the amount ranging from 5.5 pounds in the second test to 12.5 pounds in the first test. There was considerable variation in the individual weights, as shown in table 12, pages 54–55, though the advantage of the normal ration is evident. Thus, during the first half of test one the regular ration gave an average gain of 10.6 pounds and the maximum-hay ration an average loss of 18.9 pounds, showing an average advantage of 29.5 pounds in favor of the regular ration. During the second part of test one the results were much the same, though the maximum-hay ration made a better showing than it had in the first half of the test. Thus the regular-ration horses made an average gain of 7.4 pounds per head, while the maximum-hay horses made an average loss of 6.1 pounds, giving a difference of 13.5 pounds in favor of the regular ration.

During the first part of the second test both the regular and the maximum-hay rations produced gains, the regular ration an average of 24.0 pounds and the maximum-hay ration an average of 4.2 pounds, a difference of 19.8 pounds in favor of the regular ration, as shown in table 12. During the second part of the second test, the results were more marked, since the regular ration gave an average gain of 20.5 pounds while the maximum-hay ration gave an average loss of 15.2 pounds, an advantage of 35.7 pounds in favor of the regular ration. So far as the weight is concerned, this is a good showing in favor of the regular ration and emphasizes the difficulty of keeping the work horse in first-class condition on a ration low in grain content and containing a large amount of hay.

Food consumed and cost.— One of the important objects of this experiment was to test the amount of hay that a horse could consume without injury to himself, and at the same time maintain his thrift. The tabulation given on pages 56–57 shows the daily food consumption for each animal, together with the daily cost of grain and hay and the total cost for each animal.

In test one, where the grain ration consisted of two-thirds the regular ration and extra hay to make up the deficiency in nutrients, the average daily grain consumption for the horses receiving the regular ration was 16.1 pounds per head, with an average daily hay consumption of 16.1 pounds also, giving an average total food consumption of 32.2 pounds per head per day. In the maximum-hay ration, the average daily grain consumption was 10.9 pounds per head, with an average daily hay consumption of 23.0 pounds per head, thus giving an average total food consumption of 33.9 pounds per head per day, showing an excessive daily food consumption of 1.7 pounds per head for the maximum-hay ration. Similar results were obtained in test two, though the grain ration consisted of three-fourths the regular ration, the maximum-hay ration showing an excessive daily food consumption of 1.5 pounds per head.

Since the main incentive for decreasing the grain and increasing the hay is to cheapen the ration, it is interesting to note that results depend on

the relative price of the feeds. Thus, the tabulation on page 35 shows that when grain and hay are cheap the saving is not marked, ranging from 3.1 cents in test one where two-thirds normal grain ration was fed to 1.4 cents in test two where three-fourths normal grain ration was fed. However, under such conditions the annual saving ranges from $4.11 to $11.31 per head. When grain and hay are high in price, the saving is more marked, ranging from 6.3 cents a day in test one to 2.6 cents in test two. This yields an annual saving varying from $7.49 to $23.00 per head. As would be expected, the saving is most marked when grain is high in price and hay low, because in this case the daily saving ranged from 10.5 cents in test one to 5.3 cents in test two. This yields an annual saving varying from $19.34 to $38.32 a head in favor of the horses receiving the minimum-grain ration.

Digestible nutrients.— In contrasting rations of this sort, the digestible nutrient contained therein is significant, as is also the food consumed per 1000 pounds live weight, since the animals varied in size. In calculating the food consumed per 1000 pounds live weight, the average of the weekly weights was used, while in calculating the total digestible nutrients the factors used are those given by Henry and Morrison.[9]

The food consumption per 1000 pounds live weight averaged 24.8 pounds for the regular ration and 26.0 pounds for the maximum-hay ration in test one, where the grain ration consisted of two-thirds the regular ration. In test two, where the grain ration consisted of three-quarters of the regular ration, the food consumption per 1000 pounds live weight averaged 25.6 pounds for the regular ration and 26.7 pounds for the maximum-hay ration. The regular ration in test one contained 15.38 pounds digestible nutrients, and the maximum-hay ration 14.86 pounds; while the regular ration in test two contained 15.95 pounds digestible nutrients and the maximum-hay ration 15.89 pounds. It is interesting to note that the food consumption was greater in the maximum-hay ration, ranging from 1.1 pounds in test two to 1.2 pounds in test one, though the digestible nutrients were greater in the regular ration, ranging from .06 pound in test two to .52 pound in test one. This is significant, in view of the fact that the regular ration gave steady gains while on the average the maximum-hay horses lost weight, though in the first period of the second test this group did make a small gain, as shown in table 12, pages 54–55.

Appetite, health, and spirit.— Throughout the tests the appetite of the horses was good, though this was influenced by the work, which depended in part upon conditions. Occasionally a horse was indisposed, due to irregular work and a continuation of the experimental rations. While this was observed in animals receiving the regular ration, it was more frequent in the young animals receiving the maximum-hay ration. Indisposition was more noticeable in the horses shedding their milk teeth and acquiring their permanent ones, though it caused no change in their weights.

The horses were in good health throughout the test, save for minor ailments. Slight digestive disorders were observed during periods of indifferent appetite due to irregular work. In this respect the horses receiving the regular ration had the advantage.

[9] Henry, W. A., and Morrison, F. B. Feeds and feeding (1923).

In the beginning the horses were well matched in spirit and endurance, but as the test progressed a difference was often noted which was usually reflected in the weight, those holding their weight maintaining their spirit. As the test continued, the younger horses often showed a lack of spirit and endurance, even though there was little or no change in their weight. The horses receiving the regular ration showed to advantage in this matter.

CONCLUSION

Horses receiving the regular ration excelled their team mates receiving the maximum-hay ration, in body weight, in spirit, in endurance, and in physical condition.

The feasibility of decreasing the grain and increasing the hay in the ration of a working horse depends on the relative price of grain and hay. When both are cheap, and more especially when grain is cheap, such procedure would seem to be of doubtful practical value.

However, when grain and hay are high in price, economy would probably result from restricting the grain and increasing the hay, especially if the horses could be maintained in fair condition. Such economy would become more marked as grain increased in price, though the relative price of hay would also affect the cost of the ration.

GRINDING, OR CHAFFING, HAY

While there is much evidence indicating that it is advantageous to grind hay for the hard-working horse, yet there are conflicting reports as to the extent of this advantage. The statement is made that it may be of advantage to grind hay, not because the portions consumed are digested more completely, but because the horse wastes less and the cut roughage is more convenient for mixing with the grain, thus favoring a larger forage consumption.[10] The proper mixing may provide a better ration than when the grain and hay are fed separately. Whether the advantage derived from grinding, or chaffing, is sufficient to pay for the labor of grinding seems to be an open question. Accordingly, after the tests comparing the usefulness of whole and ground grain had been completed, it seemed but natural to compare the values of whole and chaffed hay.

OBJECT OF THE EXPERIMENT

The object of the experiment was to obtain information concerning the relative effect of chaffed hay and of long hay on the weight, the health, the appetite, and the spirit of the work horse.

PLAN OF THE EXPERIMENT

The plan of this investigation was very similar to that of the preceding experiment, with weights and records being kept in the same manner. There were two tests, the second consisting of two periods.

The rations

One horse of each team was fed the regular ration, consisting of oats and corn, ground and mixed half and half by weight, together with long

[10] Henry, W A., and Morrison, F. B. Feeds and feeding (1923), p 296

timothy hay. The grain and the hay were fed separately. The other horse of the team was fed the test ration, consisting of the same kind and amount of grain, together with ground or chaffed timothy hay. In the test ration, the ground grain was scattered over the ground hay. The ground timothy hay was of the same kind and quality as the long hay. In the first test the hay was of good quality, but that used in the second test was lacking in this respect. The chaffing plates were kept sharp, and the hay was cut into half-inch lengths, for the most part.

RESULTS OF THE INVESTIGATION

13. *Long hay compared with chaffed hay*

The first test was begun January 11, 1922, and was continued to March 4, 1922, a period of 52 days. The first period of the second test began November 15, 1922, and continued to January 31, 1923, a period of 77 days; then the rations were shifted so that the chaffed-hay horse became the long-hay horse. The second period continued to May 16, 1923, a period of 105 days.

To present the general results in a concise form for comparing a ration composed of long hay with one of chaffed hay, the following tabulation is given, showing average gain or loss in weight, hours worked per day, average daily food consumed, for both grain and hay, and average food consumed, per 1000 pounds live weight, for both grain and hay, for the three periods:

LONG HAY COMPARED WITH CHAFFED HAY*

Kind of ration	Long hay	Chaffed hay
Average gain or loss (pounds)	+26.9	+46.1
Average work per day (hours)	8.5	8.4
Average grain per head (pounds)	17.6	17.6
Average hay per head (pounds)	17.1	16.3
Grain per 1000 pounds live weight (pounds)	12.3	12.6
Hay per 1000 pounds live weight (pounds)	12.0	11.7

* For detailed information, see table 13, page 58.

Gain or loss of weight.— Considering the weighted average of the three trials, the long-hay horses made 26.9 pounds gain and the chaffed-hay horses made 46.1 pounds, giving an advantage of 19.2 pounds in favor of the chaffed-hay ration. The long-hay horses averaged 8.5 hours work per day, while the chaffed-hay horses averaged 8.4 hours, a slight advantage for the chaffed-hay horses. There was variation among the individual weights, as shown in table 13, on page 58, notably in the chaffed-hay horses, which ranged from a 10-pounds gain for Jerry to a 92-pounds gain for Jasper in the first test. In the three trials of this experiment, however, only one horse lost weight, and that one horse, Joab, was a long-hay horse and lost 9 pounds. Usually, the gain of the chaffed-hay horse excelled that of the long-hay horse, and as a result the average gains of the chaffed-hay horses, for each of the three periods,

excelled those of the long-hay horses in each instance. Thus, in the first test, the chaffed-hay horses had an advantage of 18.2 pounds; in the first period of the second test, an advantage of 9.5 pounds; and in the second period of the second test, an advantage of 30.8 pounds.

Appetite, health, and spirit.— The appetite of the horses was good. In the beginning, the chaffed-hay group did not relish the grain scattered over the chaffed hay; indeed, the horses of this group seemed to eat less ravenously throughout the tests. This no doubt served to protect the horses of the chaffed-hay group against the ills of too rapid eating, which, in connection with irregular work, sometimes affected the horses of the long-hay group in a manner similar to that noted in the preceding tests, where ground oats and corn meal were fed. This indisposition was more noticeable in the latter trials, due, no doubt, to the greater irregularity in the working hours.

In the main, the horses of both groups were in good health during these tests. As in the preceding tests, where a ration of ground oats and corn meal was fed, periods of irregular work were often followed by slight digestive disorders, and, no doubt, these disorders produced the indifferent appetite. As the chaffed hay covered with the grain was consumed more slowly, the appetite of this group was not only more regular, but the horses did not show indications of digestive disorders. As for the general physical condition, the chaffed-hay group excelled the long-hay group, as was shown by their fine hair, their coats, and their general appearance; but Joab, a long-hay horse, was the only one that could be said to be in poor condition.

The spirit and the general endurance of both groups was good, though the chaffed-hay group excelled, because the periods of indifference among the long-hay group did react, to some extent, on the spirit, just as they had in the preceding tests. During long-continued periods of severe labor, there was little difference among the groups in their ability to endure the work, day after day, and such difference as was noticed was reflected in the weights, since none of the horses gained so much as to interfere with their usefulness.

Relationship of rations to food consumed

In the main, both rations were consumed with relish, with only such minor indifference as has already been noted, since all the foods used were palatable to the horses. The average amount of grain consumed daily per head was similar in both groups, though the long-hay horses consumed 17.1 pounds of hay daily, whereas the chaffed-hay horses ate but 16.3 pounds, a saving of .8 pound for the chaffed-hay ration. As for the consumption of food per 1000 pounds live weight, the chaffed-hay horses ate an average of .3 pound more grain, while the long-hay horses consumed an average of .3 pound more hay.

CONCLUSION

Horses receiving the chaffed-hay ration excelled their team mates receiving long hay, in body weight, in spirit, in endurance, and in physical condition. Since both groups not only gained in weight, but improved in condition also, this experiment would seem to indicate that the advantage of chaffing was not sufficient to compensate for the labor of chaffing the

hay. Had the horses been engaged continually at severe labor, the advantage of chaffing would probably have been more marked.

Chaffing the hay decreased the hay consumption. With a given amount of grain mixed in the chaffed hay, less hay was required to meet the needs of the horse. Had the grain been restricted, as in the preceding experiment, a larger amount of chaffed hay would probably have given better results.

ALFALFA AND TIMOTHY HAY

Alfalfa hay is extensively used throughout the United States in feeding cattle and sheep. It is also used as a roughage for horses on ranches in the West, but in the East there is prejudice against its use as a horse feed. In the West, where alfalfa is often used as the sole roughage for horses, excellent results are obtained.

OBJECT OF THE EXPERIMENT

In view of the widespread prejudice against the use of alfalfa as a horse feed here in the East, it seemed worth while to conduct a test comparing its value with that of timothy, the standard hay for horses. Thus the object of the experiment was to test the safety and the efficiency of alfalfa hay as a roughage for the work horse.

PLAN OF THE EXPERIMENT

The plan of the experiment was similar to that of the preceding experiment.

The rations

Both horses of each team were fed the regular grain ration, consisting of ground oats and hominy, mixed half and half by weight, together with a bran mash every Saturday evening. One horse of each team received timothy hay, while the other horse received alfalfa hay. The horses were accustomed to alfalfa hay before the test began. Weights and records were kept as in the preceding experiment.

RESULTS OF THE EXPERIMENT

14. *Alfalfa compared with timothy hay*

This test was begun June 2, 1921, and was continued to July 1, 1921, a period of 29 days. Although the test was a very short one, it was considered of sufficient duration to show the ill effects of alfalfa hay, particularly those resulting in digestive disorders.

To present the general results in a concise form for comparing alfalfa with timothy hay, the tabulation on page 42 is given, showing average gain or loss in weight, hours worked per day, and daily food consumption, of both grain and hay, per 1000 pounds live weight.

Gain or loss of weight.— The horses receiving alfalfa hay made greater gains than did those receiving timothy, the alfalfa horses averaging 31.0 pounds and the timothy-hay horses 24.1 pounds, a difference of 6.9 pounds in favor of the alfalfa. The horses receiving alfalfa hay were much less uniform in their weights than were the horses receiving timothy hay, as shown in table 14, page 59. Thus Doll and MacGregor gained 67 and 60 pounds, respectively, and Nero lost 13 pounds. The greatest

ALFALFA HAY COMPARED WITH TIMOTHY HAY*

Kind of ration	Test period, 29 days	
	Alfalfa hay	Timothy hay
Average gain or loss (pounds)	+31 0	+24 1
Average work per day (hours)	7 6	7 7
Average grain per head (pounds)	14 5	14 5
Average hay per head (pounds)	16 9	16 9
Grain per 1000 pounds live weight (pounds)	10 6	11 2
Hay per 1000 pounds live weight (pounds)	12 4	13 0

* For more detailed information, see table 14, page 59

gain among the timothy horses, 52 pounds, was made by Jasper; and the only one to lose weight was Job, who lost but 3 pounds, though Bird, who gained but 1 pound was scarcely better.

Appetite, health, and spirit.— The appetite of both horses of each team was good, though this was influenced by their work. The alfalfa hay was consumed with fully as much relish as was the timothy hay, and no variation in appetite was traceable to either ration. Very frequently the horses receiving the alfalfa hay cleaned up their forage before the timothy horses had finished.

The health of both horses of each team was good, save for minor ailments which could in no way be traced to the forage but were probably due to irregular work. The timothy horses were as likely to show such indisposition as were the alfalfa horses.

The horses of each team were well matched in spirit and in endurance. Little difference in the team mates was observed as the test progressed, but what differences there were were in favor of the horse showing the best gains.

Food consumption.— The alfalfa horses consumed 10.6 pounds of grain per 1000 pounds live weight, and the timothy horses consumed 11.2 pounds, a saving of .6 of a pound in favor of the alfalfa ration. The same is true of the forage, the alfalfa horses consuming 12.4 pounds and the timothy horses consuming 13.0 pounds, a saving of .6 of a pound in favor of the alfalfa ration. This gives the alfalfa horses an average daily food consumption of 1.2 pounds per thousand pounds live weight less than that of the timothy horses. The usual variation in the individual food consumption was noticeable in both the alfalfa and the timothy rations, as seen in table 14, page 59.

CONCLUSION

Horses receiving alfalfa hay in their ration excelled their team mates receiving timothy hay, in body weight, in spirit, in endurance, and in physical condition. However, both groups not only gained in weight, but improved in physical condition as well.

It is significant to note that not only did the alfalfa horses excel the timothy-hay horses, but that this was accomplished on a decreased food consumption of .6 pound grain and .6 pound hay, a total daily saving of 1.2 pounds food per 1000 pounds live weight in favor of the alfalfa group.

APPENDIX

TABLE 1. Comparison of a Whole-Oats Ration with a Ration of Half Ground Oats and Half Corn Meal

Whole oats: Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)	Half ground oats and half corn meal: Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
Six-months test period: whole oats compared with half ground oats and half corn meal															
1. Jean	7	1,660	−60.0	18.0	22.8	10.8	13.7	1. Jack	7	1,620	+45.0	18.0	22.8	10.8	13.7
2. MacGregor	7	1,385	−85.0	16.8	17.0	12.4	12.5	2. MacDougal	7	1,435	−35.0	16.8	17.0	11.7	11.8
3. Signorae	4	1,360	+58.0	16.9	21.0	12.3	15.3	3. Brennae	4	1,390	+45.0	17.2	21.0	12.6	15.3
4. Jess	9	1,275	−10.0	15.3	18.7	12.4	15.1	4. Phillis	8	1,320	+55.0	15.3	18.7	11.4	13.9
5. Daisy	4	1,160	−60.0	14.5	17.6	13.1	15.9	5. Deck	5	1,255	+5.0	14.5	17.6	11.8	14.3
6. Polly	4	1,120	−73.0	12.4	16.0	11.3	14.6	6. Jinnie	4	1,130	+20.0	12.6	16.0	11.1	14.1
Average		.	−38.3	. .	.	12.0	14.5	.	. .		+22.5	.		11.6	13.8
7. Doll†	4	980	+130.0	12.0	16.0	11.2	14.9	7. Bird†	3	940	+125.0	12.0	16.0	11.9	15.9
Three-months recuperation period: half ground oats and half corn meal															
1. Jean		1,510	+115.0	15.9	23.7	10.1	15.0	1. Jack		1,525	+112.0	17.7	26.0	11.1	16.4
2. MacGregor		1,345	+86.0	13.6	18.4	9.8	13.4	2. MacDougal		1,455	−10.0	17.7	24.0	12.2	16.5
3. Signorae		1,350	+70.0	17.7	22.0	12.8	15.8	3. Brennae		1,408	+44.0	17.7	22.0	12.4	15.4
5. Daisy		1,100	+15.0	14.9	20.0	13.4	17.9	5. Deck		1,260	−10.0	14.9	20.0	11.8	15.9
6. Polly		1,047	+98.0	12.5	16.0	11.3	14.5	6. Jinnie		1,150	+40.0	12.5	16.0	10.7	13.7
7. Doll		1,105	+25.0	12.0	15.0	10.8	13.4	7. Bird		1,042	−27.0	12.0	15.0	11.6	14.5
Average		...	+68.1	...	...	11.4	15.0	.		..	+24.8	...	...	11.6	15.4

*These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights.
† Not included in average.

TABLE 2. COMPARISON OF A RATION OF HALF WHOLE OATS AND HALF SHELLED CORN WITH ONE OF HALF GROUND OATS AND HALF CORN MEAL

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)	Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight†: Grain (pounds)	Average daily food consumed per 1000 pounds live weight†: Hay (pounds)
Seven-months test period, half whole oats and half shelled corn compared with half ground oats and half corn meal															
Half whole oats and half shelled corn								Half ground oats and half corn meal							
1. Jack	10	1,637	−62.0	17.7	26.0	11.1	16.2	1. Jean	10	1,625	+10.0	17.6	26.0	10.9	16.0
2. MacDougal	10	1,445	−20.0	17.6	24.0	12.4	16.8	2. MacGregor	10	1,431	−31.0	17.6	24.0	12.6	17.1
3. Deck	8	1,250	−20.0	14.8	18.0	11.7	14.2	3. Daisy	7	1,115	+45.0	14.8	18.0	12.9	15.6
4. Jess	12	1,320	−50.0	17.7	18.0	13.6	13.8	4. Signorae	6	1,420	+90.0	17.1	22.0	11.6	14.9
5. Jinnie	6	1,190	−40.0	14.2	15.6	12.0	13.1	5. Polly	6	1,145	+15.0	14.2	15.6	12.1	13.3
Average	....	....	−38.4	.		12.1	14.8	.			+25.8	..	..	12.0	15.4
6. Doll†	6	1,130	+45.0	12.0	15.0	10.4	13.0	6. Bird†	5	1,015	+70.0	10.8	15.0	10.1	14.1
One-month recuperation period: half ground oats and half corn meal															
1. Jack		1,575	+41.0	17.7	26.0	11.1	16.3	1. Jean		1,635	+30.0	17.7	26.0	10.7	15.8
2. MacDougal		1,425	+50.0	17.7	24.0	12.2	16.6	2. MacGregor		1,400	+40.0	17.7	24.0	12.5	16.9
3. Deck		1,230	+50.0	14.8	18.0	11.8	14.3	3. Daisy		1,160	+45.0	14.8	18.0	12.6	15.2
4. Jess		1,270	+30.0	17.7	18.0	13.8	14.0	4. Signorae		1,510	+15.0	17.7	22.0	11.7	14.5
5. Jinnie		1,150	+30.0	14.8	16.0	12.8	13.7	5. Polly		1,160	+25.0	14.8	16.0	12.7	13.7
Average		..	+40.0	...	...	12.3	15.0				+31.0	.	..	12.0	15.2

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights.
† Not included in average.

TABLE 3. COMPARISON OF A GROUND-OATS RATION WITH A RATION OF HALF GROUND OATS AND HALF CORN MEAL

Six-months test period: ground oats compared with half ground oats and half corn meal																	
Ground oats									Half ground oats and half corn meal								
Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*		Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*	
					Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)						Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)
1. Jack	11	1,616	-8.0	8.1	17.7	26.0	11.1	16.2	1. Jean	11	1,665	+5.0	8.1	17.7	26.0	10.6	15.6
2. MacDougal	11	1,455	-58.0	7.4	17.7	24.0	12.5	16.9	2. MacGregor	11	1,440	-83.0	7.8	17.7	24.0	12.7	17.2
3. Jess	13	1,300	-30.0	7.9	17.7	18.0	13.7	13.9	3. Bess	12	1,120	+70.0	8.1	17.7	18.0	15.4	15.6
4. Madge	11	1,410	+20.0	8.6	17.7	22.0	12.7	15.7	4. Topsy	15	1,485	+35.0	6.0	17.7	22.0	12.0	14.9
5. Bird	6	1,050	-2.0	7.2	14.4	15.0	13.7	14.3	5. Doll	7	1,125	+60.0	7.0	14.4	15.0	12.6	13.2
Average	...		-15.6	7.8			12.7	15.4				+17.4	7.4			12.7	15.3
Two-months recuperation period: half ground oats and half corn meal																	
1. Jack		1,608	+12.0	8.6	16.8	25.0	10.4	15.4	1. Jean		1,670	0.0	8.5	17.7	25.0	10.6	14.9
2. MacDougal		1,397	+43.0	8.5	17.7	23.0	12.4	16.0	2. MacGregor		1,357	+53.0	8.2	17.7	23.0	12.7	16.5
3. Jess		1,270	+70.0	8.5	17.7	18.0	13.5	13.8	3. Bess		1,190	+55.0	8.5	17.7	18.0	14.5	14.7
5. Bird		1,048	-3.0	8.0	15.0	14.5	14.2	13.7	5. Doll		1,185	-15.0	7.2	15.0	14.5	12.7	12.3
Average		..	+30.5	8.4	.	..	12.6	14.7				+23.2	8.1			12.6	14.6

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights.

TABLE 4. COMPARISON OF A RATION OF NINE PARTS CORN MEAL AND ONE PART BRAN WITH A RATION OF HALF GROUND OATS AND HALF CORN MEAL

Nine parts corn meal and one part bran									Half ground oats and half corn meal								
Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)	Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
Six-months test period: nine parts corn meal and one part bran compared with half ground oats and half corn meal																	
1. Jean	11	1,670	-65.0	8.0	17.8	24.0	10.9	14.7	1. Jack	11	1,620	-40.0	8.2	17.6	24.0	11.0	15.0
2. Stella	10	1,140	+15.0	7.5	14.3	16.0	12.6	14.1	2. Star	12	1,160	0.0	6.1	13.8	16.0	11.8	13.7
3. MacGregor	11	1,410	+10.0	8.0	17.6	20.2	12.4	14.2	3. MacDougal	11	1,440	+30.0	8.0	16.1	19.6	11.1	13.5
4. Chloe	14	1,320	+10.0	7.9	15.1	18.0	11.5	13.7	4. Phillis	12	1,470	+60.0	8.0	15.1	18.7	10.0	12.5
5. May	4	1,300	+5.0	7.5	15.5	18.0	12.0	13.8	5. Signorae	7	1,460	+30.0	7.8	16.1	18.0	11.0	12.2
Average			-5.0	7.8			11.9	14.1				+16.0	7.6			11.0	13.4
Two-months recuperation period: half ground oats and half corn meal																	
1. Jean		1,605	-5.0	7.7	17.7	24.0	11.0	14.9	1. Jack		1,580	+15.0	7.7	17.7	24.0	11.2	15.2
2. Stella		1,160	+15.0	10.0	14.8	16.0	12.7	13.7	2. Star		1,155	+20.0	10.0	14.8	16.0	12.7	13.7
3. MacGregor		1,420	+30.0	7.5	17.4	18.0	12.1	12.5	3. MacDougal		1,470	+30.0	7.5	17.4	22.0	11.8	14.9
Average			+13.3	8.4			11.9	13.7				+21.6	8.4			11.9	14.6

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights

TABLE 5. COMPARISON OF A GROUND-OATS RATION WITH A RATION OF HALF WHOLE OATS AND HALF SHELLED CORN

Ground oats

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
Three-months test period. ground oats compared with half whole oats and half shelled corn								
1. Jack	12	1,495	+15.0	7.9	17.7	24.0	11.7	15.8
2 MacDougal	12	1,455	-10.0	8.3	17.7	22.2	12.3	15.3
3. Jinnie	8	1,220	-20.0	8.4	12.0	15.3	10.0	12.7
4 Peter	3	1,230	+15.0	8.1	15.0	18.0	12.2	14.6
5. Jennie	3	1,275	-25.0	7.7	15.0	18.0	11.8	14.2
6. Doll	8	1,140	+40.0	7.9	14.2	16.0	12.4	13.9
Average			+2.5	8.0			11.7	14.4
One-month recuperation period half ground oats and half corn meal								
1. Jack		1,510	+15.0	7.5	17.7	24.0	11.7	15.8
2. MacDougal		1,445	-20.0	7.7	17.7	22.0	12.4	15.3
3. Jinnie		1,200	-30.0	8.4	12.0	16.0	10.1	13.5
4. Peter		1,245	-15.0	7.8	15.0	18.0	12.2	14.7
5. Karen		1,280	0.0	7.8	15.0	18.0	11.7	14.1
6. Doll		1,187	+20.0	5.8	12.0	16.0	10.1	13.4
Average.			-5.0	7.5			11.4	14.5

Half whole oats and half shelled corn

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
Three-months test period								
1. Jean	12	1,545	+10.0	7.9	17.7	24.0	11.4	15.5
2. MacGregor	12	1,385	+20.0	8.3	17.7	22.0	12.6	15.7
3 Polly	8	1,200	-40.0	8.4	12.0	15.3	10.2	13.0
4. Jasper	3	1,165	-35.0	8.1	15.0	18.0	12.9	15.5
5 Nero	4	1,290	-25.0	8.0	15.0	18.0	11.8	14.1
6. Bird	7	1,020	-5.0	7.9	15.0	16.0	14.7	15.7
Average			-12.5	8.1			12.3	14.9
One-month recuperation period								
1. Jean		1,555	+25.0	5.6	17.7	24.0	11.3	15.3
2. MacGregor		1,405	-5.0	7.7	17.7	22.0	12.7	15.7
3. Polly		1,160	-15.0	8.4	12.0	16.0	10.4	13.9
4 Jasper		1,130	+40.0	7.8	15.0	18.0	13.0	15.7
5. Nero		1,265	-5.0	7.8	15.0	18.0	11.9	14.3
6 Bird		1,015	-10.0	5.2	12.0	16.0	11.8	15.8
Average			+5.0	7.1			11.8	15.1

* These columns are calculated from the average weight throughout the experiment This average weight was obtained by averaging the monthly weights

TABLE 6. COMPARISON OF A RATION OF FOUR PARTS HOMINY, FOUR PARTS WHEAT FEED, AND ONE PART LINSEED-OIL MEAL WITH A RATION OF HALF HOMINY AND HALF GROUND OATS. (FOUR- TO SIX-MONTHS TEST PERIOD)

Four parts hominy, four parts wheat feed, and one part linseed-oil meal

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*	
					Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)
1. Jean	13	1,580	-45 0	8 4	18 5	24 0	12 0	15 5
2. Mabel	12	1,280	+15 0	8 5	18 0	18 0	13 8	13 8
3. Pomona	5	1,365	+40 0	6 5	16 4	20 0	11 8	14 4
4. Maude	7	1,200	+25 0	7 6	15 0	18 0	12 5	15 0
5. Signorina	5	1,130	+40 0	7 9	15 0	18 0	12 9	15 5
6. Belle	5	1,145	+65 0	7 7	15 7	18 0	13 4	15 3
7. MacDougal	13	1,425	-15 0	8 3	18 7	22 0	13 0	15 3
8. Signorae	9	1,430	+50 0	8 3	18 0	18 0	12 3	12 3
9. Nero	5	1,260	+60 0	7 6	17 0	19 3	13 3	15 1
10. Jimmie	9	1,170	- 5 0	8 3	12 0	16 0	10 2	13 6
Average	....		+23 0	7 9	..	.	12 5	14 6
11. Start†	14	1,050	+150 0	10 5	15 0	18 0	13 1	15 7

Half hominy and half ground oats

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*	
					Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)
1. Jack	13	1,525	+ 5 0	8 4	18 5	24 0	12 2	15 8
2. Olive	13	1,470	0 0	7 4	18 0	24 0	12 2	16 3
3. Krupp	5	1,300	+20 0	7 5	17 4	18 0	13 1	13 5
4. Deck	11	1,270	+40 0	8 0	15 0	18 0	11 9	14 2
5. Jennie	4	1,240	+ 5 0	7 1	14 8	18 0	11 9	14 5
6. Bertha	4	1,070	+50 0	7 9	15 8	18 0	14 6	16 6
7. MacGregor	13	1,400	-25 0	8 3	18 7	22 0	13 6	16 0
8. Negro	11	1,470	+ 5 0	8 3	17 6	23 6	12 0	16 0
9. Karen	4	1,280	+100 0	7 6	17 0	19 3	12 9	14 6
10. Polly	9	1,145	-10 0	8 3	12 0	16 0	10 6	14 2
	.	.	+19 0	7 9			12 5	15 2
11. Stella†	12	1,050	+150 0	10 5	15 0	18 0	13 1	15 8

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights
† Not included in average.

TABLE 7. COMPARISON OF A RATION OF HALF GROUND OATS AND HALF HOMINY WITH A RATION OF HALF GROUND OATS AND HALF CORN MEAL

Six-months test period half ground oats and half hominy compared with half ground oats and half corn meal

Half ground oats and half hominy

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacGregor	13	1,375	+65.0	8.1	18.0	22.0	12.7	15.5
2. Nix	3	1,420	0.0	7.5	16.5	18.0	11.7	12.7
3. Karen	4	1,380	+15.0	8.2	18.0	20.0	12.8	14.2
4. Peter	4	1,280	+50.0	7.9	18.0	18.0	13.6	13.6
5. Bertha	4	1,120	+60.0	6.4	15.0	18.0	13.0	15.6
6. Stella	12	1,200	-15.0	10.5	15.0	18.0	12.4	14.9
7. Polly	9	1,135	+15.0	8.2	12.8	16.0	11.1	13.8
8. Bird	8	1,080	+80.0	7.7	15.0	16.0	13.4	14.3
Average	....	..	+33.7	8.1	..	.	12.6	14.3

Half ground oats and half corn meal

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacDougal	13	1,410	+70.0	7.9	18.0	22.0	12.3	15.0
2. Nemo	3	1,450	-60.0	7.5	16.5	18.0	11.7	12.7
3. Nero	5	1,320	-5.0	8.0	18.0	20.0	13.6	15.1
4. Jasper	4	1,195	+50.0	7.9	18.0	18.0	14.5	14.5
5. Belle	5	1,210	+45.0	6.5	15.0	18.0	12.1	14.5
6. Star	14	1,200	0.0	10.5	15.0	18.0	12.5	15.0
7. Jinnie	9	1,165	+30.0	8.2	12.8	16.0	10.7	13.3
8. Doll	9	1,190	+20.0	7.2	15.0	16.0	12.5	13.3
.			+18.7	8.0	.		12.5	14.2

One-month recuperation period

Half ground oats and half corn meal

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacGregor		1,440	+5.0	8.8	18.0	22.0	12.5	15.3
2. Nix		1,420	-10.0	8.5	18.0	18.0	12.7	12.7
3. Karen		1,395	-10.0	8.5	18.0	20.0	12.9	14.4
4. Peter		1,330	+5.0	8.6	18.0	18.0	13.5	13.5
5. Bertha		1,180	+5.0	5.6	15.0	18.0	12.7	15.2
6. Stella		1,185	+10.0	10.5	15.0	18.0	12.6	15.1
7. Polly		1,150	-10.0	8.7	15.0	16.0	13.1	14.0
8. Bird		1,160	-30.0	8.3	15.0	16.0	13.1	14.0
Average		......	-4.4	8.4	.	....	12.9	14.3

Half ground oats and half hominy

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacDougal		1,480	+5.0	8.8	18.0	22.0	12.1	14.8
2. Nemo		1,390	-20.0	8.5	18.0	18.0	13.0	13.0
3. Nero		1,315	-5.0	8.5	18.0	20.0	13.7	15.2
4. Jasper		1,245	0.0	8.6	18.0	18.0	14.5	14.5
5. Belle		1,255	+20.0	5.6	15.0	18.0	11.9	14.2
6. Star		1,200	-5.0	10.5	15.0	18.0	12.5	15.0
7. Jinnie		1,195	-5.0	8.7	15.0	16.0	12.6	13.4
8. Doll		1,210	-10.0	5.8	15.0	16.0	12.4	13.3
..		...	-2.5	8.1	..	..	12.8	14.2

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights.

TABLE 8. COMPARISON OF A WHOLE-OATS RATION WITH A RATION OF HALF WHOLE OATS AND HALF SHELLED CORN. (SIX-MONTHS TEST PERIOD)

Whole oats

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacDougal	14	1,485	-65.0	7.7	17.9	19.9	12.6	13.9
2. Nemo	4	1,370	-45.0	8.2	17.9	18.0	13.3	13.4
3. Signorina	6	1,215	+25.0	8.1	17.9	18.0	14.7	14.8
4. Karen	5	1,385	+35.0	8.1	17.9	20.0	13.0	14.5
5. Jasper	5	1,245	-60.0	8.3	17.9	18.0	14.8	14.8
6. Jennie	5	1,290	-20.0	8.7	14.9	18.0	11.6	14.0
7. Polly	10	1,140	+20.0	8.0	13.4	16.0	11.6	13.9
8. Orpha	6	1,205	+25.0	7.4	15.0	18.0	12.5	15.0
9. Belle	6	1,255	-70.0	8.1	14.9	18.0	12.2	14.7
Average	...	.	-17.2	8.0	...	.	12.9	14.3

Half whole oats and half shelled corn

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacGregor	14	1,445	-5.0	7.6	17.9	19.9	12.5	13.8
2. Nix	4	1,410	+10.0	7.9	17.9	18.0	12.7	12.8
3. Signorae	10	1,500	-35.0	8.2	17.9	18.0	12.1	12.2
4. Nero	6	1,310	-35.0	8.3	17.9	20.0	13.9	15.4
5. Peter	5	1,335	-75.0	8.3	17.9	18.0	13.7	13.8
6. Lady	6	1,240	0.0	8.7	14.9	18.0	12.1	14.6
7. Jinnie	10	1,190	-5.0	8.0	13.5	16.0	11.3	13.3
8. Chloe	17	1,360	+15.0	5.5	14.9	16.0	11.1	11.9
9. Bertha	5	1,165	-40.0	8.1	14.9	18.0	13.0	15.6
Average			-18.9	7.8			12.5	13.7

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights

TABLE 9. COMPARISON OF A RATION OF HALF GROUND OATS AND HALF HOMINY WITH A RATION OF HALF GROUND OATS AND HALF CORN MEAL. (THREE-MONTHS TEST PERIOD)

Half ground oats and half hominy

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacGregor	14	1,440	-10.0	8.0	18.0	18.0	12.5	12.5
2. Nix	4	1,420	+25.0	8.1	18.0	18.0	12.4	12.4
3. Karen	5	1,420	-55.0	6.8	18.0	18.0	12.8	12.8
4. Peter	5	1,260	+40.0	8.4	18.0	18.0	13.8	13.8
5. Lady	6	1,240	+60.0	8.3	15.0	16.0	11.7	12.5
6. Orpha	6	1,230	+50.0	6.2	15.0	16.0	11.9	12.7
7. Bertha	5	1,125	-30.0	8.1	15.0	16.0	13.5	14.4
Average.	......	......	+11.4	......	.....	....	12.7	13.0
8. Mary	4	1,370	+40.0	7.6	18.0	18.0	13.0	13.0
9. Topsy	4	1,290	0.0	8.4	18.0	16.0	13.9	12.4
10. Bird	9	1,135	+15.0	6.5	15.0	16.0	12.8	13.7
11. Star	15	1,170	-10.0	10.5	15.0	12.0	12.8	10.2
12. Jess	16	1,255	+20.0	7.7	15.0	16.0	11.9	12.7
Average.	......	.....	+13.0	.....	...	..	12.9	12.4
Average of all	.....	..	+12.1	7.9			12.8	12.8

Half ground oats and half corn meal

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. MacDougal	14	1,420	-5.0	7.9	18.0	18.0	12.7	12.7
2. Nemo	4	1,325	+30.0	8.1	18.0	18.0	13.3	13.3
3. Nero	6	1,275	+55.0	3.7	18.0	18.0	13.6	13.6
4. Jasper	5	1,185	+10.0	8.3	18.0	18.0	15.0	15.0
5. Jennie	5	1,270	+50.0	8.3	15.0	16.0	11.5	12.2
6. Chloe	17	1,375	-40.0	8.3	15.5	18.0	11.5	13.3
7. Belle	6	1,185	-10.0	8.2	15.0	16.0	12.6	13.5
...	..	.....	+12.9	....	.	..	12.9	13.4
8. John	4	1,235	+5.0	7.4	18.0	18.0	14.7	14.7
9. Tip	4	1,210	+30.0	8.4	18.0	16.0	14.7	13.1
10. Doll	10	1,250	-45.0	8.2	15.0	16.0	12.2	13.0
11. Stella	13	1,125	-25.0	10.5	15.0	12.0	13.5	10.8
12. Bess	15	1,200	+55.0	7.1	15.0	16.0	12.3	13.2
..	.. ...	......	+4.0	......	.. ..	....	13.5	13.0
			+9.2	8.0			13.1	13.2

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights

TABLE 10. COMPARISON OF A WHOLE-OATS RATION WITH A GROUND-OATS RATION. (THREE-MONTHS TEST PERIOD)

Whole oats

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*	
					Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)
1. MacDougal	14	1,415	+35.0	8.5	18.0	18.0	12.6	12.6
2. Nemo	4	1,355	+20.0	8.5	18.0	18.0	13.2	13.2
3. Nero	6	1,330	+15.0	8.6	18.0	18.0	13.4	13.4
4. Brenda	5	1,345	-15.0	7.7	15.0	16.0	11.1	11.9
5. Tip	4	1,240	+15.0	8.3	15.0	16.0	12.0	12.8
6. Mildred	4	1,245	-35.0	7.4	15.0	16.0	12.2	13.0
7. Jasper	5	1,195	+30.0	8.5	18.0	18.0	14.9	14.9
8. Doll	10	1,205	+5.0	8.4	15.0	16.0	12.4	13.3
9. Belle	6	1,175	+25.0	8.2	15.0	16.0	12.7	13.5
10. Star	15	1,160	-20.0	10.4	15.0	12.0	12.9	10.3
11. Chloe	17	1,335	-45.0	8.5	18.0	16.0	13.7	12.2
Average		...	+2.7	8.4	...		12.8	12.8

Ground oats

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*	
					Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)
1. MacGregor	14	1,430	+20.0	8.5	18.0	18.0	12.5	12.5
2. Nix	4	1,445	0.0	8.6	18.0	18.0	12.4	12.4
3. Karen	5	1,365	+35.0	8.6	18.0	18.0	12.9	12.9
4. Marguerite	3	1,390	-5.0	7.7	15.0	16.0	10.8	11.5
5. Topsy	4	1,290	-5.0	8.2	15.0	16.0	11.7	12.5
6. Orpha	6	1,280	+70.0	7.9	15.0	16.0	11.5	12.3
7. Peter	5	1,300	+15.0	8.5	18.0	18.0	13.7	13.7
8. Bird	9	1,150	-10.0	8.5	15.0	16.0	13.0	13.9
9. Bertha	7	1,095	+20.0	8.2	15.0	16.0	13.6	14.5
10. Stella	13	1,100	-35.0	10.3	15.0	12.0	13.9	11.1
11. Signorae	11	1,450	0.0	8.5	18.0	18.0	12.3	12.2
...	.	.	+9.5	8.5	...	...	12.6	12.7

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights.

TABLE 11. COMPARISON OF A RATION OF HALF WHOLE OATS AND HALF HOMINY WITH A RATION OF HALF GROUND OATS AND HALF HOMINY. (SIX-MONTHS TEST PERIOD)

Half whole oats and half hominy									Half ground oats and half hominy								
Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*		Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed		Average daily food consumed per 1000 pounds live weight*	
					Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)						Grain (pounds)	Hay (pounds)	Grain (pounds)	Hay (pounds)
1. MacDougal	15	1,450	+35.0	8.6	18.0	18.0	12.4	12.4	1. MacGregor	15	1,450	+60.0	8.6	18.0	18.0	12.2	12.2
2. Nemo	5	1,375	+25.0	8.6	18.0	18.0	12.9	12.9	2. Nix	5	1,445	+65.0	8.7	18.0	18.0	12.3	12.3
3. Nero	7	1,345	-15.0	8.5	18.0	18.0	13.7	13.7	3. Karen	6	1,400	+55.0	8.4	18.0	18.0	12.9	12.9
4 Brenda	6	1,330	+35.0	8.3	17.2	16.0	12.8	11.9	4. Marguerite	4	1,385	+30.0	8.3	17.2	16.0	12.5	11.6
5. Jonah	3	1,275	0.0	6.5	15.0	16.0	11.9	12.7	5. Jude	3	1,360	+40.0	6.4	15.0	16.0	11.0	11.6
6 Jasper	6	1,225	0.0	8.7	18.0	18.0	14.9	14.9	6. Peter	6	1,315	+45.0	8.7	18.0	18.0	13.7	13.7
7. Topsy	5	1,285	+55.0	8.5	17.1	16.5	13.2	12.7	7. Tip	5	1,255	+20.0	8.5	17.2	16.5	13.9	13.3
8. Polly	11	1,180	-15.0	8.0	12.0	16.0	10.5	14.0	8 Jinnie	11	1,175	0.0	8.0	12.0	16.0	10.2	13.7
9. Belle	7	1,200	+15.0	8.5	15.0	16.0	12.5	13.3	9. Bertha	8	1,115	+35.0	8.5	15.0	16.0	13.3	14.2
10. Doll	11	1,210	+60.0	8.3	15.0	16.0	12.2	13.0	10. Bird	10	1,140	+55.0	8.3	15.0	16.0	13.0	13.8
Average	....	. .	+19.5	8.2	. .	.....	12.7	13.1	. .. .	. .	. .	+40.5	8.2	.		12.5	12.9

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights

TABLE 12. COMPARISON OF A REGULAR RATION WITH A RATION OF MINIMUM GRAIN AND MAXIMUM HAY AND WITH A MAXIMUM-HAY RATION

Regular ration								Minimum grain and maximum hay							
Name of horse	Initial weight (pounds)	Gain or loss (pounds)	Average daily food consumed per 1000 pounds live weight*					Name of horse	Initial weight (pounds)	Gain or loss (pounds)	Average daily food consumed per 1000 pounds live weight*				
			Grain		Hay		Total digestible nutrients (pounds)				Grain		Hay		Total digestible nutrients (pounds)
			Amount eaten (pounds)	Digestible nutrients (pounds)	Amount eaten (pounds)	Digestible nutrients (pounds)					Amount eaten (pounds)	Digestible nutrients (pounds)	Amount eaten (pounds)	Digestible nutrients (pounds)	
First test, 112 days															
First half of first test, 56 days, 48 work days															
1. Nix	1,471	+3.0	12.1	9.14	12.3	5.97	15.11	1. Nemo	1,433	-9.0	8.5	6.40	17.7	8.58	14.98
2. Peter	1,339	+36.0	13.0	9.82	12.4	6.01	15.83	2. Jasper	1,360	+3.0	8.8	6.63	16.3	7.91	14.54
3. Jude	1,442	+45.0	12.1	9.14	12.3	5.97	15.11	3. Jonah	1,372	-8.0	8.8	6.63	19.2	9.31	15.94
4. Job	1,330	+24.0	13.2	9.97	13.0	6.30	16.27	4. John	1,352	-36.0	9.0	6.78	20.1	9.75	16.53
5. Josh	1,368	-6.0	10.8	8.15	10.8	5.24	13.39	5. Jake	1,247	-34.0	8.2	6.17	17.5	8.49	14.66
6. Joe	1,172	-14.0	12.7	9.58	13.7	6.64	16.22	6. Jerry	1,152	-30.0	8.7	6.54	20.1	9.75	16.29
7. Doll	1,294	-3.0	11.4	8.60	10.2	4.95	13.55	7. Bird	1,200	-38.0	8.4	6.32	16.0	7.76	14.08
8. Mildred	1,257	-5.0	11.8	8.91	12.4	6.01	14.92	8. Star	1,167	-19.0	8.6	6.47	17.2	8.34	14.81
9. Nate	1,276	+15.0	11.6	8.75	12.3	5.97	14.72	9. Jim	1,223	+1.0	8.2	6.17	17.4	8.44	14.61
Average	. . .	+10.6	12.1	9.12	12.2	5.89	15.01	. . .	.	-18.9	8.6	6.46	17.9	8.70	15.16
Second half of first test, 56 days, 48 work days															
1. Nemo	1,424	-11.0	12.4	9.37	12.4	6.01	15.38	1. Nix	1,474	+27.0	8.1	6.10	18.1	8.78	14.88
2. Jasper	1,363	-11.0	13.1	9.90	11.7	5.67	15.57	2. Peter	1,375	-46.0	8.9	6.70	16.7	8.10	14.80
3. Jonah	1,364	+19.0	12.0	9.75	13.0	6.30	16.05	3. Jude	1,487	-8.0	8.1	6.10	17.9	8.68	14.78
4. John	1,316	+16.0	13.2	9.97	13.5	6.55	16.52	4. Job	1,354	0.0	8.9	6.70	17.8	8.64	15.33
5. Jake	1,213	+12.0	12.2	9.21	13.0	6.30	15.51	5. Josh	1,362	+6.0	7.2	5.41	16.9	8.20	13.61
6. Jerry	1,122	+29.0	13.2	9.96	14.2	6.89	16.85	6. Joe	1,158	+8.0	8.6	6.47	19.1	9.26	15.73
7. Bird	1,162	0.0	12.8	9.66	11.3	5.48	15.14	7. Doll	1,291	-16.0	7.9	5.94	14.3	6.94	12.88
8. Star	1,148	-19.0	13.0	9.81	12.2	5.92	15.73	8. Mildred	1,252	-42.0	8.1	6.09	17.6	8.54	14.63
9. Jim	1,224	+32.0	11.9	8.98	12.6	6.11	15.09	9. Nate	1,291	+16.0	7.7	5.79	17.6	8.54	14.33
Average	. . . .	+7.4	12.7	9.62	12.7	6.14	15.76	. . .	. . . . . .	-6.1	8.2	6.14	17.3	8.41	14.55
Average, 112 days	. . .	+9.0	12.4	9.37	12.4	6.02	15.38	.	. . . . .	-12.5	8.4	6.30	17.6	8.55	14.86

Second test, 100 days

First half of second test, 50 days, 43 work days															
1 Nix	1,474	+17 0	11 9	8 99	12 1	5 87	14 86	1. Nemo	1,383	-4 0	10 7	8 07	15 6	7 57	15 64
2 Signorae	1,409	+6.0	12 6	9 52	12 6	6 11	15.63	2. MacGregor	1,428	+19 0	10 4	7 85	14 7	7 13	14 98
3. Joy	1,307	-1 0	13 5	10 20	13 4	6 50	16 70	3. Jasper	1,295	-13 0	11 5	8 68	16 0	7 76	16 44
4 Jude	1,467	+27 0	12 0	9 07	12 1	5 87	14 94	4. Jonah	1,374	+11 0	10.7	8 07	16 2	7 86	15 93
5. Job	1,310	+55 0	13 1	9 90	13 2	6 40	16 30	5. John	1,325	+7 0	11 1	8 38	17 1	8 29	16 67
6. Joe	1,193	+24 0	14 6	11 03	12 7	6 16	17 19	6. Jerry	1,186	+2 0	12 5	9 43	17 0	8 25	17 68
7. Josh	1,334	+35 0	13 1	9 90	11 7	5 67	15 57	7. Jim	1,183	+21 0	12 3	9 28	16 1	7 81	17 09
8 Doll	1,212	+29 0	12.1	9 13	12 0	5 82	14 95	8 Bird	1,141	-9 0	10 1	7 61	15 8	7 66	15 27
Average	....	+24 0	12 9	9 72	12 5	6 05	15 77	......	....	+4 2	11 2	8 42	16 1	7 79	16 21
Second half of second test, 50 days, 42 work days															
1. Nemo	1,379	+7 0	12.8	9 67	12 9	6 26	15 93	1. Nix.	1,491	-31 0	10 0	7 55	15.3	7 42	14 97
2 MacGregor	1,447	+20 0	12 1	9 14	11 3	5 48	14 62	2. Signorae	1,415	-25 0	10 6	8.00	15 4	7 47	15 47
3. Jasper	1,282	+23 0	13 6	10 28	12 3	5 97	16 25	3. Joy	1,306	+33.0	11.1	8 38	16 8	8 15	16 53
4. Jonah	1,385	+12 0	12.7	9 60	12 7	6 16	15.76	4. Jude	1,494	-8 0	10 0	7 55	15 3	7.42	14 97
5 John*	1,332	+20 0	13 3	10 05	13 4	6 50	16 55	5. Job	1,365	-26 0	11 0	8 30	16 3	7 91	16 21
6. Jerry	1,189	+9 0	14.9	11 26	12 6	6 11	17 37	6. Joe	1,217	-13.0	12.3	9 28	16 0	7 76	17.04
7. Jim	1,204	+24 0	14 5	10 96	12 5	6 06	17 02	7. Josh	1,369	-38 0	11 0	8 30	15 4	7 47	15 77
8 Bird	1,132	+49 0	12 8	9 66	12 2	5 92	15 58	8 Doll	1,241	-14 0	9 6	7 23	13 1	6 35	13 58
Average	....	+20.5	13 3	10 08	12 5	6 06	16 13	....	......	-15 2	10 7	8 07	15 5	7 49	15 57
Average, 100 days	.....	+22 2	13 1	9 90	12 5	6 05	15 95	...	.	-5 5	10 9	8 25	15 8	7 64	15 89

* These columns are calculated from the average weight throughout the experiment This average weight was obtained by averaging the monthly weights.

TABLE 12 (*concluded*)

Regular ration: Name of horse	Age (years)	Average daily work (hours)	Average daily food and cost per head: Grain: Amount eaten (pounds)	Grain: Cost (cents)	Hay: Amount eaten (pounds)	Hay: Cost (cents)	Total cost (cents)	Maximum hay: Name of horse	Age (years)	Average daily work (hours)	Average daily food and cost per head: Grain: Amount eaten (pounds)	Grain: Cost (cents)	Hay: Amount eaten (pounds)	Hay: Cost (cents)	Total cost (cents)
First test, 112 days															
First half of first test, 56 days, 48 work days															
1. Nix	7	8.5	17.7	24.8	18.0	10.8	35.6	1. Nemo	7	8.5	12.0	16.8	25.2	15.1	31.9
2. Peter	8	7.2	17.7	24.8	16.9	10.1	34.9	2. Jasper	8	7.2	12.0	16.8	22.2	13.3	30.1
3. Jude	5	8.4	17.7	24.8	17.9	10.7	35.5	3. Jonah	5	8.4	12.0	16.8	26.2	15.7	32.5
4. Job	5	7.8	17.7	24.8	17.4	10.4	35.2	4. John	6	7.8	12.0	16.8	26.9	16.1	32.9
5. Josh	4	6.3	14.9	20.9	14.9	8.9	29.8	5. Jake	4	5.8	10.0	14.0	21.4	12.8	26.8
6. Joe	4	7.8	14.9	20.9	16.0	9.6	30.5	6. Jerry	5	7.8	10.0	14.0	23.0	13.8	27.8
7. Doll	13	8.4	14.9	20.9	13.2	7.9	28.8	7. Bird	12	8.4	10.0	14.0	19.2	11.5	25.5
8. Mildred	7	10.0	14.9	20.9	15.6	9.4	30.3	8. Star	18	10.0	10.0	14.0	20.0	12.0	26.0
9. Nate	5	5.8	14.9	20.9	15.9	9.6	30.5	9. Jim	4	6.2	10.0	14.0	21.3	12.8	26.8
Average		7.8	16.1	.	16.2		32.3			7.8	10.9		22.8		28.9
Second half of first test, 56 days, 48 work days															
1. Nemo	7	7.8	17.7	24.8	17.6	10.6	35.4	1. Nix	7	7.8	12.0	16.8	26.6	16.0	32.8
2. Jasper	8	7.9	17.7	24.8	15.8	9.5	34.3	2. Peter	8	7.9	12.0	16.8	22.7	13.6	30.4
3. Jonah	5	8.3	17.7	24.8	17.8	10.7	35.5	3. Jude	5	8.3	12.0	16.8	26.4	15.8	32.6
4. John	6	7.6	17.7	24.8	18.0	10.8	35.6	4. Job	5	8.2	12.0	16.8	24.0	14.4	31.2
5. Jake	4	6.1	14.9	20.9	15.9	9.5	30.4	5. Josh	4	6.1	10.0	14.0	23.3	14.0	28.0
6. Jerry	5	7.5	14.9	20.9	16.0	9.6	30.5	6. Joe	4	7.5	10.0	14.0	22.1	13.3	27.3
7. Bird	12	7.7	14.9	20.9	13.1	7.9	28.8	7. Doll	13	7.7	10.0	14.0	18.3	11.0	25.0
8. Star	18	9.5	14.7	20.6	13.8	8.3	28.9	8. Mildred	7	9.0	10.0	14.0	21.8	13.1	27.1
9. Jim	4	6.9	14.7	20.6	15.5	9.3	29.9	9. Nate	5	7.2	10.0	14.0	22.9	13.7	27.7
Average	..	7.7	16.1		15.9		32.2			7.7	10.9		23.1		29.1
Weighted average	..	7.8	16.1	.	16.1		32.2	....	.	7.8	10.9		23.0		29.1

Second test, 100 days

First half of second test, 50 days, 43 work days															
1. Nix	8	8 4	17 7	24.8	17 9	10 7	35 5	1. Nemo	8	8 4	14 9	20 9	21 7	13 0	33 9
2. Signorae	15	8 6	17 7	24 8	17 7	10 6	35 4	2. MacGregor	17	8 6	14 9	20 9	21 1	12 7	33 6
3. Joy	5	8 1	17 7	24 8	17 5	10 5	35 3	3 Jasper	9	8 2	14 9	20 9	20 7	12 4	33 3
4. Jude	6	8.6	17 7	24 8	17 9	10 7	35 5	4. Jonah	6	8 6	14 9	20 9	22 4	13 4	34 3
5. Job	6	8 1	17 7	24 8	17 8	10 7	35.5	5. John	7	8 1	14 9	20 9	22 9	13 7	34 6
6 Joe	5	7 3	17 7	24 8	15 4	9 2	34 0	6. Jerry	6	7 3	14 9	20 9	20 3	12 2	33 1
7 Josh	5	7 1	17 7	24 8	15 9	9 5	34 2	7. Jim	5	7 2	14 9	20 9	19 5	11 7	32 6
8. Doll	14	7 9	14 9	20 9	14 8	8 9	29.8	8. Bird	13	7 9	12 0	16 8	17 9	10 7	27 5
Average	...		17 3	..	16 9	..	34 4			.	14 5	.	20 8		32 9
Second half of second test, 50 days, 42 work days															
1. Nemo	8	8 4	17 7	24 8	17 9	10 7	35 5	1 Nix	8	8 4	14 9	20 9	22 7	13 6	34 5
2. MacGregor	17	8 1	17 7	24 8	16 5	9 9	34 7	2 Signcrae	15	8 1	14 9	20 9	21 7	13 0	33 9
3. Jasper	9	8 2	17 7	24 8	15 9	9 5	34 3	3. Joy	5	8 2	14 9	20 9	22 5	13 5	31 4
4. Jonan	6	8 6	17 7	24 8	17 7	10 6	35 4	4. Jude	6	8 6	14 9	20 9	22 8	13 7	34 6
5. Jonn	7	8 2	17 7	24 8	17 9	10 7	35 5	5. Job	6	8 2	14 9	20 9	22 1	13 3	34 2
6 Jerry	6	8 6	17 7	24 8	14 9	8 9	33 7	6. Joe	5	8 6	14 9	20 9	19 4	11 6	32 5
7. Jim	5	8 2	17 7	24 8	15 2	9 1	33 9	7. Josh	5	7 8	14 9	20 9	20 8	12 5	33 4
8. Bird	13	7 7	14 9	20 9	14 2	8 5	29 4	8. Doll	14	7 7	12 0	16 8	16 4	9 8	26 6
Average	..	.	17 3	.	16 3	.	34 0	.		.	14 5		21 0		33 0
Weighted average	... ...	8 1	17 3	.. .	16 6		34 2			8 1	14 5		20 9		32 8

TABLE 13. COMPARISON OF LONG HAY WITH CHOPPED HAY

Long hay: Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)	Chopped hay: Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
First test, 52 days, 45 work days																	
1. Joe	6	1,240	+26.0	8.4	15.0	16.0	12.0	12.9	1. Jerry	7	1,210	+10.0	8.6	15.0	16.0	12.4	13.2
2. Josh	6	1,456	+21.0	8.6	18.0	18.0	12.3	12.3	2. Jim	6	1,334	+51.0	8.8	18.0	17.4	13.2	12.8
3. Nix	9	1,520	+41.0	8.9	18.0	18.0	11.6	11.6	3. Nemo	9	1,386	+58.0	8.9	18.0	17.9	12.7	12.7
4. MacGregor	18	1,457	+26.0	8.7	18.0	18.0	12.2	12.2	4. John	8	1,383	+47.0	8.7	18.0	17.9	12.7	12.7
5. Joy	6	1,383	+58.0	8.7	18.0	18.0	12.8	12.8	5. Jasper	10	1,299	+92.0	8.6	18.0	17.7	13.3	13.2
6. Jude	7	1,484	+41.0	9.0	18.0	18.0	12.0	12.0	6. Jonah	7	1,392	+64.0	8.9	18.0	17.9	12.6	12.6
Average	...		+35.5	8.6	17.5	17.7	12.2	12.3	....	.	...	+53.7	8.8	17.5	17.5	12.8	12.9
Second test, first period, 77 days, 66 work days																	
1. Jasper	11	1,283	+45.0	8.1	17.7	15.4	13.5	11.7	1. Joy	7	1,428	+40.0	8.1	17.7	18.0	12.2	12.4
2. Joab	5	1,389	-9.0	8.1	17.7	17.1	12.8	12.3	2. Nero	12	1,417	+36.0	8.4	17.7	17.3	12.2	11.9
3. Jim	7	1,308	+33.0	8.5	17.7	16.3	13.4	12.3	3. Josh	7	1,433	+18.0	8.5	17.7	18.0	12.3	12.4
4. Nemo	10	1,395	+10.0	8.8	17.7	16.9	12.6	12.0	4. Nix	10	1,541	+23.0	8.8	17.7	18.0	11.1	11.6
Average		.	+19.8	8.4	17.7	16.4	13.1	12.1	.	.	...	+29.3	8.4	17.7	17.8	12.0	12.1
Second test, second period, 105 days, 90 work days																	
1. Joy	.	1,468	+51.0	8.1	17.7	17.2	11.9	11.5	1. Jasper	.	1,328	+51.0	7.6	17.3	10.6	12.8	7.9
2. Nero	....	1,453	+19.0	7.5	17.4	15.7	12.0	10.9	2. Joab	.	1,380	+82.0	7.0	17.7	15.2	12.5	10.7
3. Josh		1,451	+8.0	8.6	17.7	17.5	12.2	12.0	3. Jim	.	1,341	+26.0	8.6	17.7	12.6	13.1	9.3
4. Nix	...	1,564	+6.0	8.5	17.7	17.4	11.3	11.1	4. Nemo	.	1,405	+48.0	8.5	17.7	14.1	12.4	9.9
Average	.....		+21.0	8.2	17.6	17.0	11.9	11.4	..			+51.8	7.9	17.6	13.1	12.7	9.5
Weighted average	....	...	+26.9	8.5	17.6	17.1	12.3	12.0	.....	...	....	+46.1	8.4	17.6	16.3	12.6	11.7

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights

TABLE 14. COMPARISON OF ALFALFA HAY WITH TIMOTHY HAY. (TEST PERIOD: 29 DAYS, 25 WORK DAYS)

Alfalfa hay

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. Jude	6	1,461	+47	8 0	14 9	17 9	10 0	12 0
2. Joy	5	1,302	+43	7 9	14 9	18 0	11 2	13 6
3. Nero	10	1,347	-13	7 9	14 9	18 0	11 1	13 4
4. MacGregor	18	1,412	+60	7 3	14 9	15 9	10 3	11 0
5. Mildred	8	1,283	+7	7 9	17 7	17 0	12 3	11 8
6 Nix	8	1,443	+55	7 5	14 9	18 0	10 1	12 2
7. Josh	5	1,370	+19	7 1	14 9	18 0	10 8	13 1
8. Doll	9	1,221	+67	7 3	12 0	14 5	9 6	11 6
9. Joe	5	1,180	-6	7 9	11 9	14 9	10 1	12 6
Average	. .	.	+31	7 6	14 5	16 9	10 6	12 4

Timothy hay

Name of horse	Age (years)	Initial weight (pounds)	Gain or loss (pounds)	Average daily work (hours)	Average daily food consumed: Grain (pounds)	Average daily food consumed: Hay (pounds)	Average daily food consumed per 1000 pounds live weight*: Grain (pounds)	Average daily food consumed per 1000 pounds live weight*: Hay (pounds)
1. Jonah	6	1,387	+31 0	8 0	14 9	17 8	10 6	12 6
2. Jasper	9	1,293	+52 0	8 0	14 9	14 9	11 3	11 3
3. Job	6	1,330	-3 0	7 9	14 9	17 7	11 2	13 3
4 John	7	1,310	+28 0	7 3	14 9	18 0	11 2	13 5
5. Cora	10	1,282	+35 0	7 7	17 7	18 0	13 3	13 5
6. Nemo	8	1,362	+49 0	7 5	14 9	18 0	10 7	12 9
7. Jim	5	1,212	+7 0	7 3	14 9	17 7	12 2	14 6
8. Bird	13	1,148	+1 0	7 5	12 0	14 3	10 4	12 5
9. Jerry	6	1,152	+17 0	7 9	12 0	15 4	10 3	13 2
. . . . . .	. . . .	. . . .	+24 1	7 7	14 5	16 9	11 2	13 0

* These columns are calculated from the average weight throughout the experiment. This average weight was obtained by averaging the monthly weights.

March, 1925 Bulletin 438

Economic Studies of Dairy Farming in New York. III

Grade B Milk with Alfalfa Roughage

E. G. Misner
In cooperation with the Bureau of Agricultural Economics of the United States Department of Agriculture

MAIN BUILDINGS OF A GRADE B MILK FARM IN MADISON COUNTY

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CONTENTS

ECONOMIC STUDIES OF DAIRY FARMING IN NEW YORK

III. GRADE B MILK WITH ALFALFA ROUGHAGE

E. G. MISNER[1]

The types of farming found in any section are the results of trial and experiment by the farmers with the natural conditions of the region. New York once grew 39,072 acres of hops. This crop has practically disappeared from the farming system. Hop yards are now producing milk, cabbage, and potatoes, a change which shows considerable economic advancement. The dairy farmer who grew hops must therefore seek something else to provide the cash crop in his system.

In 1889, three times as many acres of barley were grown in New York as were grown in 1919. In 1844, 46,089 acres of flax were raised in the State, but none are grown now. These are examples of crops that are disappearing or have disappeared from the farming system.

In contrast to these is the cabbage crop, which has increased in acreage, and the alfalfa crop, with an acreage in the State of 5582 in 1899, 35,343 in 1909, and 119,783 in 1919. This crop was more than tripled in acreage in ten years. Much of this increase has occurred in regions more especially adapted to enterprises other than dairying; but in dairy regions with calcareous soil, alfalfa has increased so much that buildings which were formerly adequate no longer provide sufficient storage room for all the roughage grown.

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[1] The writer was assisted in the field in 1922 by I. J. Call, M. J. B. Ezekiel, J. F. Harriott, E. R. Hoskins, Bruce McKinley, W. G. Meal, C. H. Merchant, and J. J. Vernon, and in the preparation of the blanks used by W. C. Funk. In 1923, William Allen and J. F. Booth assisted in the field. The information was gathered through the cooperation of the Department of Agricultural Economics and Farm Management (G. F. Warren, in charge), New York State College of Agriculture at Cornell University, Ithaca, New York, the Division of Cost of Production (R. H. Wilcox, in charge) and the Division of Farm Management (H. R. Tolley, in charge) of the Bureau of Agricultural Economics (H. C. Taylor, Chief), United States Department of Agriculture, Washington, D. C.

The following farmers cooperated in furnishing information for both years of the investigation:

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Landlords: Frank Adams, Carlos Coleman, Thomas Davis, G. Forward, John Frost, Frank Gill, O. S. Langsworthy, M. Loucy, C. E. Love, E. Lyons, William S. Moot, Miss Anna Parker, Solon Parks, Tim Rohrer, D. Stebbins, Grant Stringer.

The following farmers furnished records for 1921, but either did not furnish them, or their records were not used, for 1922:

Operators: Guy Barlett, N. E. Bishop, H. Boylan, A. D. Branagan, George Enck, G. and L. Goodrich, Fred C. Halsey, Leon B. Hickox, J. P. Jones, W. J. Nichols, L. A. Nower, Charles March, F. F. Rice, F. H. Rivenburgh, Clarence Rowe, Newton Spooner, Fred Virgil, W. Wheeler, Clarence D. Whipple, John Whipple, C. E. Witter, G. E. Woods.

Landlords: Frank Burleson, R. W. Clifford, Lyman Green, R. B. Hickox, F. W. Marshall, Fred Mitchell, Lillian Moot, Peck Estate, Willis R. Putnam, E. J. Spaulding, A. J. Thurston.

The following farmers furnished records for 1922, but not for 1921:

Operators: R. B. Hickox, C. J. Miller, E. J. Spaulding.

Landlords: Mrs. F. Clark, and Mrs. Brown.

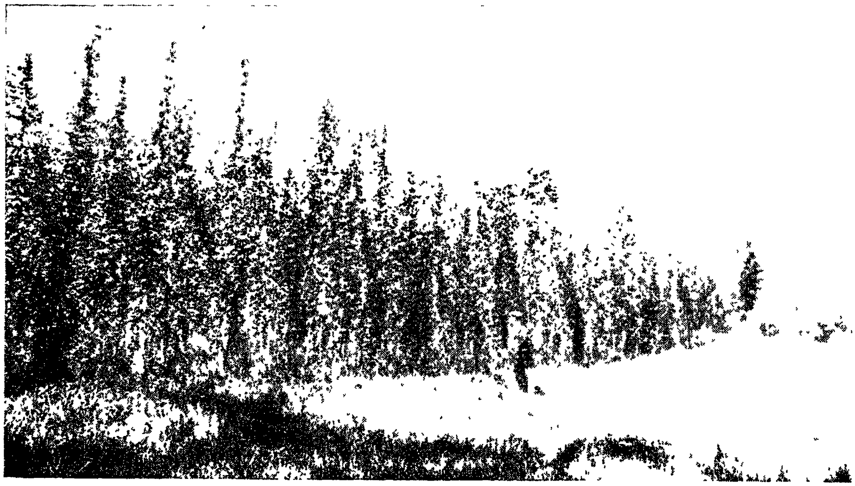

FIGURE 1. HOPS, A CROP WHICH IN MANY LIMESTONE SOILS IS BEING REPLACED BY ALFALFA FOR DAIRY COWS

The utilization, and conversion into human food, of pasture grasses, straws, hays, fodders, and other by-products of the farm, is accomplished more efficiently by the dairy cow than by any other farm animal. As the better lands of the world are cultivated, it becomes increasingly important to convert these rough, bulky, and inedible-to-man products into human food with the least waste and the greatest economic advantage. This means that the animals whose function it is to do this, the organization of the business for this purpose, and the principles of nutrition that establish the success with which it is done, must be developed with the highest degree of human understanding. A relatively small proportion of the milk of the State is produced under systems in which alfalfa is used. However, data as to the business organization of dairy farms in an alfalfa region, and the relation of feeding practices and the composition of the ration to the economics of milk production, will help to satisfy curiosity and to furnish a correct understanding of the advantages of this crop.

REGIONAL CONDITIONS IN MADISON COUNTY

The first white settlers came to Madison County in 1790, settling on the Oneida Indian Reservation. The county was set off from Chenango in 1806, and was rapidly filled chiefly with people from New England.

The northern part of the county is a low glacial-lake plain at an elevation of from 370 to 450 feet. The drainage of this area is toward the north. From Pratts Hollow and Morrisville southward, the drainage is into the Susquehanna system.

The larger part of the county is upland at an elevation of from 1000 to 2160 feet. The Chenango River system has its origin in the southern half of the county, with three or more branches joining and passing out of the county at Earlville as the Chenango River.

The average date of the last killing frost in the spring is May 23, and of the first in the fall, September 30. These allow for a growing season of 130 days. The average annual precipitation from 1903 to 1917 was 40.7 inches. The rainfall in the growing season from April to August inclusive was 18.4 inches.

Of the 125 records that were taken in Madison County, 70 were obtained in the town of Stockbridge, and most of the remainder in the four towns south of there.

The normal amount of rainfall at Cazenovia in this area of Madison County at an elevation of 1200 feet, and the amount in each of the crop seasons studied, are given in table 1:

TABLE 1. AMOUNT OF RAINFALL IN AREA STUDIED FOR TWO CROP SEASONS, COMPARED WITH NORMAL AMOUNT

	Normal amount of rainfall at Cazenovia (inches)	Amount of rainfall (inches)		Per cent of normal amount	
		Cazenovia, 1921	Morrisville, 1922	1921	1922
May	3.60	2.41	3.55	66.9	98.6
June	4.54	3.20	10.32	70.5	227.3
July	4.10	4.45	2.05	108.5	50.0
August	3.87	4.54	4.60	117.3	118.9
September	3.88	1.63	1.03	42.0	26.5
Total	19.99	16 23	21.55	81.2	107.8

The town of Stockbridge was chosen because there, perhaps, dairying with alfalfa hay as roughage is conducted more intensively than in any other township in the State. The deep, narrow valley of Oneida Creek extends northward thru the center of the township. In the valley, the soils contain more clay and are not so well drained, so that alfalfa does not thrive so well there as on the slopes and uplands where the soil is a gravelly loam abounding in lime. Stockbridge Hill, on which the white settlers are said to have found apple orchards when they acquired the land from the Indians, has soil as good as the better soils of western New York and the additional advantage for dairying of a heavier summer rainfall. Travel from it to the towns and railroads in the valley is over rough and very steep roads, so that it is less intensively farmed than is the valley land.

The upland soils of this area are probably of the Ontario series and mostly what was mapped in the original Syracuse area survey as Cazenovia loam. This is a gravelly calcareous soil, which does not hold pasture grass too well, and on which all crops suffer from drought, alfalfa to a less degree than the others. Because the long taproot of the alfalfa penetrates deep enough to get moisture, and because alfalfa is more easily grown on land of rough, broken, steep topography than are cultivated crops, this crop is especially well adapted to this area.

A comparison of the averages of selected items for the town of Stockbridge, Madison County, as shown by the census data of 1920, with the averages for the 108 farms included in 1922, is given in table 2. The

TABLE 2. DATA FROM THE UNITED STATES CENSUS OF 1920 FOR THE TOWN OF STOCKBRIDGE, MADISON COUNTY, COMPARED WITH THE AVERAGES FOR THE 108 FARMS IN MADISON COUNTY SURVEYED FOR 1922

Item	Stockbridge farms, January 1, 1920			108 farms in 1922		
	Number of farms	Total	Average per farm	Number of farms	Total	Average per farm
Farms and farm acreages:						
Number of farms	218	......	.....	108	......	.....
All land in farms (acres)	.....	18,990	87	.....	15,618	145
Improved land in farms (acres)	.....	13,908	64	.....	10,081†	93
Distribution of farms according to size (acres of all land):						
3 to 9 acres	18	......	.....	.....	......	.....
10 to 19 acres	17	......	.....	.....	......	.....
20 to 49 acres	28	......	.....	1	......	.....
50 to 99 acres	77	......	.....	28	......	.....
100 to 174 acres	57	......	.....	49	......	.....
175 to 259 acres	18	......	.....	26	......	.....
260 acres and over	3	......	.....	4	......	.....
Total	218	......	.....	108	......	.....
Selected crops:						
Crops cut for silo (acres)	104	789	7.6	96	894	9.3
Oats (acres threshed for grain)	133	825	6.2	81	743	9.2
Alfalfa hay (acres)	181	3,185	17.6	107	3,368	31.5
Other hay (acres)	168	2,377*	14.1	55	707	12.9
Hops (acres)	3	33	11.0	3	28	9.3
Potatoes (acres)	128	152	1.2	103	116	1.1
Cabbage (acres raised for sale)	2	0.6	.....	14	39	2.8
Dairy cows on farm:						
Dairy cows two years old and over	189	2,478	13.1	108	2,066	19.1
Farms reporting dairy cows, classified according to number of cows reported:						
1 to 4 cows	43	......	.....	.....	......	.....
5 to 9 cows	31	......	.....	4	......	.....
10 to 19 cows	75	......	.....	64	......	.....
20 to 29 cows	27	......	.....	28	......	.....
30 cows and over	13	......	.....	12	......	.....
Total	189	......	.....	108	......	.....

* Includes 384 acres of "timothy and alfalfa mixed," reported by 13 farms.
† Includes acres of crops, rotated pasture, and permanent pasture tillable.

chief difference between the township and the survey averages is that the farms included for the study reported here had more cows and a larger acreage of alfalfa. This results from excluding the farms with less than eight cows, and also excluding those hill farms that are more distant from the Stockbridge valley, as these farms have less alfalfa.

The community center for the farms studied is the village of Munnsville, which has about 500 inhabitants. An alfalfa-grinding mill is located there. No other places of business are in the town except the usual

stores, garages, and a hotel. There is no bank; business is done chiefly thru banks at Oneida, eight miles north. In 1923, electric lights were extended from Oneida to Munnsville, serving the farmers on the way.

The lack of a bank in the immediate community discourages the usually good business methods which such an institution stimulates, but the small valley is so hemmed in by rugged country that if there were sufficient business to support a bank it probably would be in existence.

AGE, TENURE, AND WAGES

Of the 125 farm operators on farms studied in the crop season of 1921, 38 had attended high school for an average of 2.7 years, 8 had attended business school for 0.9 year, and 2 had attended college for 1.2 years. The average age of the 125 farmers was 46 years.

Of the total number of farmers, 106 owned all the land they farmed, 16 were share tenants, and 3 were cash tenants.

The average age at which operators became owners of farms was 36 years, and the average age at which they became tenants was 30 years. A large number of the farmers passed thru the tenant stage before they

TABLE 3. PRECEDING TENURE STATUS OF PRESENT OPERATORS

	Present tenure status			
	Owners	Share tenants	Cash tenants	All operators
Number of farms	106	16	3	125
Average age of operator (years)	48	37	35	46
Average age at which operator began present status (years)	36	......	.....	....
Average years in present status	11.8	....	....	....
Tenant on present farm:				
Number of farmers	21	16	3	40
Average age when farmer began tenancy (years)	27	32	31	30
Average years in such status	6.3	4.7	4 3	5.5
Tenant on other farms:				
Number of farmers	36	6	....	42
Average age when farmers began tenancy (years)	29	28	....	29
Average years in such status	8.4	7.5	....	8.3
Hired man at home:				
Number of farmers	60	12	1	73
Average age when farmer began as hired man (years)	17	18	16	17
Average years in such status	8.5	9.6	2.0	8.6
Hired man away from home:				
Number of farmers	34	9	1	44
Average age when farmer began as hired man (years)	19	20	14	19
Average years in such status	8.0	7.0	10.0	7.8
Other occupations:				
Number of farmers	40	7	2	49
Average age when farmer began such occupation (years)	22	25	19	22
Average years in such status	12.7	5.7	11.5	11.6

acquired the ownership of a farm. The data for the preceding tenure status of present operators are given in table 3, and those for their employment history in table 4.

TABLE 4. EMPLOYMENT HISTORY OF 125 FARM OPERATORS

	Owner of present farm but never owner of other farms	Owner of other farms before becoming or while owner of present farm	Share tenants	Cash tenants
Total number of this tenure status....	85	21	16	3
Number that never had been tenants	43	9	......	....
Number that had been tenants on present farm but never on other farms..........	18	0	10	3
Number that had been tenants on other farms but never on present farm..........	21	12	.....	......
Number that had been tenants both on other farms and on present farm	3	0	6	0
Total number that had worked as hired men on farms..........	71	13	16	2
Number that had worked as hired men on home farm but not on other farms..........	43	7	7	1
Number that had worked as hired men on other farms but not on home farm..........	20	4	4	1
Number that had worked as hired men both on other farms and on home farm..........	8	2	5	0
Number that had never worked as hired men on farms but had been engaged in other occupations..........	7	6	0	1
Number that had neither worked as hired men on farms nor been engaged in other occupations..........	7	2	0	0
Number that had worked as hired men on farms and had been engaged in other occupations..........	22	5	7	1
Number that had worked as hired men on farms but had never been engaged in other occupations..........	49	8	9	1

Only 108 of the 125 farms included for the crop year of 1921 were included for the 1922 crop year. Of the operators on 17 farms for which records were not obtained in the second year, eleven refused to give data, one changed to other work during the year, one had sold the cows, and one was seriously ill. Three records were omitted after enumeration because of incompleteness.

The average value placed by the farm operators on their time for twelve months was \$938 in 1921 and \$967 in 1922. This includes board but not privileges. The average time spent by 124 operators was 11.7 months

per farm, and by the 108 operators in 1922, 11.6 months per farm. The variations in the estimates placed upon their time by the farm operators is shown in table 5. They range from $400 to $1800 per year. The majority of estimates were $600, $900, $1000, or $1200 per year.

TABLE 5. VARIATIONS IN ESTIMATES PLACED BY FARM OPERATORS ON THE VALUE OF THEIR TIME FOR TWELVE MONTHS

Value of operator's labor	125 farms in 1921		108 farms in 1922	
	Number of farms	Per cent	Number of farms	Per cent
$ 400	1	0 8	...	...
408	...	...	1	0.9
480	3	2.4	...	...
500	...	...	1	0.9
540	1	0 8	1	0.9
592	1	0.8	...	...
567	1	0 8	...	...
600	13	10 4	8	7.4
650	1	0.8	2	1.9
660	...	...	1	0.9
680	...	...	1	0.9
700	2	1.6	...	...
720	7	5 6	7	6.5
750	5	4.0	2	1.9
780	2	1.6	2	1.9
800	...	...	3	2.8
820	...	...	1	0.9
840	4	3 2	4	3.7
850	...	...	1	0.9
900	27	21.6	20	18.5
935	...	...	1	0.9
945	...	...	1	0.9
960	5	4.0	...	...
992	...	...	1	0.9
1,000	15	12.0	17	15.8
1,020	2	1 6	1	0.9
1,080	4	3.2	2	1.9
1,100	2	1.6	...	...
1,200	19	15 2	21	19.5
1,232	1	0.8	...	...
1,440	1	0.8	...	...
1,500	8	6.4	8	7.4
1,800	...	...	1	0.9
Total	125	100.0	108	100.0

The average monthly wage paid to hired men without board was $58.91 per month in 1921 and $61.50 per month in 1922; and the cash wages paid to hired men with board, $40.98 per month in 1921 and $40.72 per month in 1922 (tables 6 and 7). The value of the board furnished, except the part furnished by the farm, averaged $17.98 per month in 1921 and $18.09 per month in 1922.

Of the total months worked by persons other than operators, 41.4 per cent in 1921, and 41.9 per cent in 1922, was unpaid labor. Of the total

TABLE 6. LABOR ON 125 FARMS IN 1921

	Number of farms using	Months worked			Value of unpaid labor		Total wages		Average per month worked	
		Total	Per cent	Per farm	Total	Average per month	Cash	Board	Cash	Board
Operator's wife:										
Unpaid	54	170.5	7.7	3.2	$ 7,668	$44.97	...	...	...	...
Operator's sons:										
Paid	8	58	2.6	7.2	...	...	$ 2,510	$ 1,006	$43.28	$22.86
Unpaid	54	548	24.9	10.1	29,077	53.06	...	...	...	...
Operator's daughters:										
Paid	1	2	0.1	2.0	...	...	86	30	40.00	15.00
Unpaid	3	4	0.2	1.3	182	45.50	...	...	...	...
Operator's other relatives:										
Paid	3	26	1.2	8.7	...	...	923	494	35.50	19.00
Unpaid	18	127	5.8	7.1	7,306	57.53	...	...	...	...
Second operator	4	48	2.2	12.0	3,940	82.08	...	...	...	...
Landlord	1	12	0.5	12.0	420	35.00	...	...	...	...
Hired men without board	25	274	12.4	11.0	...	...	16,141	...	58.91	...
Hired men with board	66	738.7	33.5	11.2	...	...	30,274	$13,281	40.98	17.98
Hired men by day:										
Without board	46	162.6	7.4	3.5	...	...	10,501	...	64.58	...
With board	27	31.75	1.4	1.2	...	...	2,273	662	71.59	20.85
Other help, unpaid	1	2	0.1	2.0	50	25.00	...	...	...	...
Total labor, except operator	125	2,204.55	100.0	17.6	$48,643	$53 37	$62,702	$15,473	$48.49	$18 37
Operator	124	1,445	...	11.7	$112,790	$ 78.06	...	...	...	...
Son's time as operator	2	8	...	4.0	567	70.88	...	...	...	...
Second operator's time as operator	1	8	...	8.0	800	100 00	...	...	...	...
Hired men's time as operator	6	39	...	6.5	3,074	78.82	...	...	...	...
Total for operator for 12 months	125	1,500	...	12.0	$117,231	$ 78.15	...	...	...	...
Man equivalent	...	...	...	2.47	...	...	...	...	...	...

TABLE 7. LABOR ON 108 FARMS IN 1922

	Number of farms using	Months worked			Value of unpaid labor		Total wages		Average per month worked	
		Total	Per cent	Per farm	Total	Average per month	Cash	Board	Cash	Board
Operator's wife:										
Unpaid	42	141	8.4	3.4	$ 7,067	$50.12	...	...	...	...
Operator's sons:										
Paid	12	103	6.2	8.6	...	...	$ 4,230	$ 1,740	$41.47	$17.58
Unpaid	34	327	19.5	9.6	15,930	48.72	...	...	...	...
Operator's daughters:										
Paid	1	2	0.1	2.0	...	...	60	40	30.00	20.00
Unpaid	2	2	0.1	2.0	82	41.00	...	...	...	...
Operator's other relatives:										
Paid	3	24	1.4	8.0	...	...	454	450	21.62	18.75
Unpaid	14	137.5	8.2	9.8	10,705	77.85	...	...	...	...
Second operator	7	84	5.0	12.0	6,460	76.90	...	...	...	...
Landlord	1	12	0.7	12.0	420	35.00	...	...	...	...
Hired men without board	12	94.5	5.6	7.9	...	...	5,812	...	61.50	...
Hired men with board	70	658.5	39.2	9.4	...	...	26,609	11,912	40.72	18.09
Hired men by day:										
Without board	40	60.2	3.6	1.5	...	...	5,309	...	88.19	...
With board	13	33.9	2.0	2.6	...	...	2,202	582	64.96	17.17
Total labor, except operator	107	1,679.6	100.0	15.7	$40,664	$57.80	$44,676	$14,724	$46.20	$18.01
Operator	108	1,248	...	11.6	$101,923	$81.67	...	...	...	...
Son's time as operator	3	19	...	6.3	1,060	55.79	...	...	...	...

TABLE 7 (*concluded*)

	Number of farms using	Months worked			Value of unpaid labor		Total wages		Average per month worked	
		Total	Per cent	Per farm	Total	Average per month	Cash	Board	Cash	Board
Brother's time as operator	1	2	...	2 0	$ 92	$46.00	...	....	...	...
Son-in-law's time as operator..	1	8	..	8.0	400	50 00	.....	..	....	...
Hired man's time as operator	4	19	. .	4 8	995	52.37	. .	. .	...	....
Total for operator for 12 months ...	108	1,296	....	12.0	$104,470	$80 61	.	. .		
Man equivalent	....	...	....	2 31	. ..	.....	... .		...	. .

months of labor on the farm, 40.5 per cent in 1921 and 43.5 per cent in 1922 was worked by operators or persons taking the place of operators. Thus it may be seen that of the total labor on the farm, 65.1 per cent in 1921 and 67.2 per cent in 1922 was the work of the farm operator and other unpaid labor, chiefly members of the operators' families.

The average number of persons equivalent to men, computed on a yearly basis (man equivalent), was 2.47 in 1921 and 2.31 in 1922.

FARM CAPITAL

In the other regions studied in the series of which this report is one, no farms were included with less than twelve cows; but since the farms were smaller in th s area, the limit to the number of cows was lowered to include farms with eight cows.

The average size of the 125 farms in 1921 was 141 acres, with 63 acres, or 45 per cent of the area, in crops. The average size of the farms included in 1922 was 145 acres, with the same area in crops. (Table 8.)

TABLE 8. AVERAGE SIZE OF FARMS

	125 farms in 1921		108 farms in 1922	
	Average acres per farm	Per cent of total acres	Average acres per farm	Per cent of total acres
Crops..................	63.0	44.8	62.7	43.4
Woods pastured*........... ..	10.5	7.5	11.9	8.2
Rotated pasture....	4 4	3.1	5.2	3.6
Permanent pasture tillable....... .	23.0	16.4	25.4	17.6
Other permanent pasture.......... .. .	26.4	18.8	28.7	19.8
Woods not pastured............... ...	5.8	4.1	5 5	3.8
Farmstead, roads, and so forth...	7.5	5.3	5.2	3.6
Total...................... ..	140.6	100.0	144.6	100.0

* Equivalent to 2.2 acres of open pasture for 125 farms in 1921, and to 2.1 acres for 108 farms in 1922.

A noticeable condition in this region is that nearly half of the permanent pasture is considered by the farmers to be tillable. Very little land is in rotated pasture.

The value of the land and buildings was obtained for each farm from the farmers in 1921, and in revisiting the farms in 1922 the question was asked whether or not it would be necessary to revise the value given the preceding year because of improvements or other changes which would affect the value of the farms. The farm values were readjusted when necessary, but when no changes had been made the value of the farm used in 1922 was the same as in 1921.

The capital per farm averaged $15,371 in 1921 and a little above this in 1922. Of this amount $11,000, or about 72 per cent, was in real estate, about 20 per cent in livestock, and the remainder in machinery and in feed and supplies. The amount of capital in real estate, in livestock, and in machinery for the farms each year, is shown in table 9:

TABLE 9. AVERAGE CAPITAL FOR FARMS IN EACH YEAR

	125 farms in 1921		108 farms in 1922	
	Value per farm	Per cent of total	Value per farm	Per cent of total
Real estate	$11,030	71.8	$11,343	72 8
Livestock	3,033	19.7	3,011	19.3
Machinery	1,203	7.8	1,215	7.8
Feed and supplies	105	0.7	19	0.1
Total	$15,371	100.0	$15,588	100 0

Of the total capital represented by the farm real estate, about 15 per cent was in the operator's dwellings and 17 per cent in the cattle barns. The capital in all buildings constituted 43.7 per cent of the value of the farm. The value of the crop land was placed at 34.4 per cent of the value

TABLE 10. DISTRIBUTION OF FARM REAL-ESTATE CAPITAL FOR 125 FARMS IN 1921

	Value per farm	Per cent of total
Dwelling no. 1	$1,687	15.2
Dwelling no. 2 (31 farms)	261	2.4
Dwelling no. 3 (5 farms)	25	0.2
Cattle barn	1,862	16.8
Barn no. 2 (68 farms)	415	3.7
Other buildings	603	5 4
Total buildings	$4,853	43.7
Orchard	$ 91	0.8
Crop land	3,823	34.4
Pasture land, except woods pastured	1,726	15.6
Woodland	564	5.1
Other land	45	0.4
Total land	$6,249	56.3
Total value of farm (land and buildings)	$11,102	100.0

of the farm; the value of the pasture, except woods pastured, was 15.6 per cent of the value. The average values per acre of the land were: crop land, $61; pasture land, $32; woodland, $35. The value of the farm real estate on April 30, 1922, for the 125 farms was as shown in table 10.

FARM RECEIPTS

Of the total income from these farms, 57.4 per cent in 1921 was cash for milk sold, and 3.0 per cent was in certificates of indebtedness of the Dairymen's League Cooperative Association, Inc.; 9.8 per cent was from livestock sold, and 18.7 per cent was from crops sold (table 11). In 1922, the cash for milk sold comprised 65.7 per cent of the total receipts, certificates of indebtedness 2.3 per cent, livestock sold 13.4 per cent, and income from crops 14.9 per cent. The total receipts per farm in 1921 were $4278, and in 1922 $3697 or about 14 per cent less per farm.

TABLE 11. AVERAGE RECEIPTS PER FARM

	125 farms in 1921		108 farms in 1922	
	Average per farm	Per cent of total	Average per farm	Per cent of total
Crops sold	$ 801	18.7	$ 551	14.9
Livestock sold	418	9.8	495	13.4
Milk sold:				
Cash	2,457	57.4	2,428	65.7
Certificates of indebtedness	129	3.0	87	2.3
Increase in inventory	342	8.0	2	0.1
Miscellaneous	131	3.1	134	3.6
Total	$4,278	100.0	$3,697	100.0

CROPS

The crops grown, the total yields, and the receipts for each year, are shown in tables 12 and 13. The cropping system on the farms considered is a rotation of corn for the silo followed by oats and then by alfalfa. The acreage of alfalfa is about four times that of corn for the silo. Of the

TABLE 12. CROPS RAISED ON 125 FARMS IN 1921

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Corn for grain	110	6,072	Bushels	6	$ 5	......	......
Stover from corn for grain	......	148	Tons	3	10	......	......
Corn for the silo*	959	11,437	Tons	123	411	......	......
Corn for the silo, surplus	23 5	145	Tons	6	15	......	......
Grain from corn for the silo	......	4,874	Bushels	118	302	......	......
Corn for fodder, cured	9	40	Tons	......	......	......	......
Corn for the silo, surplus fed green	11	126	Tons	......	......	......	......
Sweet corn fed green	1.5	9	Tons	......	......	......	......
Other corn fed green	13.3	177	Tons	20	15	20	$ 15
Oats*	895	29,164	Bushels	141	112	......	......
Oat straw	......	684	Tons	23.5	218	......	......
Oats and barley	122	4,062	Bushels	......	......	......	......

* On one farm there were 23.5 acres of corn for the silo, oats, wheat, second-cut alfalfa, and potatoes, worked on shares. The work was done by a neighbor, who received one-half of each of the crops.

TABLE 12 (*concluded*)

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Oat and barley straw	...	73	Tons	...	...	...	...
Barley	80	1,769	Bushels	58	$ 54	...	...
Barley†	12	...	Tons	...	...	...	...
Barley straw	...	58.5	Tons	...	...	...	...
Buckwheat‡	(3)	120	Bushels	...	...	...	...
Buckwheat	22	491	Bushels	65	65	...	...
Buckwheat straw	...	12.5	Tons	...	...	...	...
Rye	6	120	Bushels	...	...	...	...
Rye straw	...	3	Tons	...	...	...	...
Winter wheat*	266	6,173	Bushels	3,722	4,419	77	$ 97
Wheat straw	...	168.5	Tons	43.5	404	...	...
Oats, barley, and peas	36	1,231	Bushels	...	...	...	...
Oat, barley, and pea straw	...	24	Tons	...	...	...	...
Oats, peas, barley, and wheat	6	240	Bushels	...	...	...	...
Oat, pea, barley, and wheat straw	...	4	Tons	...	...	...	...
Oat and wheat straw	...	26	Tons	5	65	...	...
Oat, barley, and wheat straw	...	14	Tons	...	...	...	...
Timothy hay for bedding	...	1	Tons	...	...	...	...
Oats for hay	38	58	Tons	...	...	...	...
Oats for hay (land rented out)‡	(3)	2.5	Tons	...	...	...	...
Oats and peas for hay	5	9	Tons	...	...	...	...
Buckwheat fed green	5	31	Tons	...	...	...	...
Alfalfa fed green, first cutting	16	67	Tons	...	...	...	...
Alfalfa fed green, second cutting‡	(292.5)	574.5	Tons	...	...	...	...
Alfalfa fed green, third cutting‡	(567)	828	Tons	...	...	...	...
Alfalfa fed green, fourth cutting‡	(3)	4	Tons	...	...	...	...
Alfalfa, first cutting	3,621	5,763	Tons	951	12,516	30.5	411
Alfalfa, first cutting (new seeding)‡	(16)	17	Tons	...	...	...	...
Alfalfa, first cutting (share-rented land)‡	(20)	26	Tons	...	...	...	...
Alfalfa, second cutting‡*	(3,198.5)	3,261	Tons	1,025.3	17,009	37.7	594
Alfalfa, second cutting (rented land)‡	(15)	20	Tons	...	...	...	...
Alfalfa, third cutting‡	(640.5)	481.5	Tons	28	531	...	...
Alfalfa, fourth cutting‡	(10)	6	Tons	...	...	...	...
Mixed hay (clover)	132	192	Tons	20	300	...	...
Mixed hay (other)	574	549	Tons	111	1,430	...	...
Timothy	273	373.5	Tons	23	412	...	...
Rowen	...	27	Tons	...	...	...	...
Potatoes*	114.8	12,244	Bushels	3,793.5	3,969	305.5	302
Cabbage	9.8	74	Tons	62	1,681	7	210
Cabbage refuse	...	15	Tons	...	...	...	...
Factory peas	88	1,279	Hundredweight	1,269.5	3,911	7.5	24
Market peas§	152.5	17,382	Bushels	15,182	32,422	950	2,203
Peavines, harvested (green)	5	5	Tons	...	...	...	...
Peavines, green	...	39	Tons	...	...	...	...
Field beans	9.2	179	Bushels	101	508	60	288
String beans	10	600	Bushels	600	500	...	...
Hops	62	41,656	Pounds	36,656	12,945	5,000	750
Hop roots	...	...	...	...	15	...	...
Turnips	2	2	Tons	...	...	...	...
Beets	1.7	44	Tons	...	...	...	...
Mangels	1.8	20	Tons	...	...	...	...
Celery and pumpkins	...	...	...	...	17	...	...
Apples, young trees	4	...	...	...	...	...	...
Apples, bearing‖	169	...	Barrels	249	608	...	...
Apples and cherries	7	...	...	...	...	...	...
Cherries and berries	...	...	...	...	125	...	...
Garden	0.5	...	...	...	...	...	...
Fallow land	5	...	...	...	...	...	...
1920 alfalfa, first cutting sold	...	...	Tons	7	86	...	...
1920 timothy sold	...	...	Tons	3	90	...	...
1920 hay (other) sold	...	...	Tons	2.5	30	2.5	30
Total	7,878.6	...	...	...	$95,200	...	$4,924

*On one farm there were 23.5 acres of corn for the silo, oats, wheat, second-cut alfalfa, and potatoes, worked on shares. The work was done by a neighbor, who received one-half of each of the crops.
† Twelve acres of barley used for bedding, for which no yield was found.
‡ Areas in parenthesis are not included in total acres of crops.
§ Contracting grower took 1250 bushels.
‖ Most of the orchards of this area consisted of scattered trees, and the yields were not ascertained.

TABLE 13. CROPS RAISED ON 108 FARMS IN 1922

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Corn for grain	52	1,642	Bushels.	...	...	...	...
Stover from corn for grain	...	103	Tons	2	$ 10	...	...
Corn for the silo	894	8,590	Tons	5	15	...	...
Corn for the silo, surplus	2	6	Tons	...	...	...	...
Grain from corn for the silo	...	725	Bushels.	...	...	...	...
Sweet corn, green*	7	...	...	...	...	...	...
	3	32	Hundred-weight	32	45	...	...
Other corn fed green†	(6)	1	Tons	...	...	...	...
	12	107	Tons	...	...	...	...
Oats	743	20,999	Bushels.	250	125	150	$ 75
Oat straw	...	629	Tons	24	170	3	10
Oats and barley	98	3,115	Bushels.	...	...	...	...
Oat and barley straw	...	79	Tons	2	20	...	...
Barley	43	1,016	Bushels.	80	92	...	...
Barley straw	...	30	Tons	...	...	...	...
Speltz	3	90	Bushels.	...	...	...	...
Speltz straw	...	1	Tons	...	...	...	...
Buckwheat†	(15)	200	Bushels.	50	100	...	...
	11	223	Bushels.	10	15	...	...
Buckwheat straw	...	13	Tons	...	...	...	...
Rye	5	56	Bushels.	14	14	...	...
Rye straw	...	5	Tons	3	27	...	...
Winter wheat	146	2,869	Bushels.	1,580	1,875	...	...
Spring wheat	9	125	Bushels.	70	74	...	...
Wheat straw	...	131.5	Tons	12.5	118	...	...
Oats and peas	10	250	Bushels.	...	...	...	...
Oat and pea straw	...	7	Tons	3	15	...	...
Oats, barley, peas, spring wheat, and buckwheat	6	210	Bushels.	...	...	...	...
Oat, barley, pea, spring wheat, and buckwheat straw	...	8	Tons	...	...	...	...
Peas for hay	6	10	Tons	...	...	...	...
Oats for hay	26	33	Tons	...	...	...	...
Rye for hay	2	5	Tons	...	...	...	...
Alfalfa fed green, first cutting:							
From old meadows	2	9	Tons	...	...	...	...
From new seeding†	(5)	5	Tons	...	...	...	...
Alfalfa fed green, second cutting†	(211)	362	Tons	...	...	...	...
Alfalfa fed green, third cutting†	(375)	398	Tons	...	...	...	...
Alfalfa for the silo†	(15)	30	Tons	...	...	...	...
Alfalfa, first cutting	3,366	5,772	Tons	935.5	10,058	11.5	160
Alfalfa, second cutting†	(2,671)	2,368	Tons	816.5	13,086	4.5	65
Alfalfa, third cutting†	(252)	166	Tons	48	792	...	...
Mixed hay (clover)	126	245	Tons	6	96	...	...
Sweet clover	12	50	Tons	...	...	...	...
Mixed hay (other)	394	559	Tons	103	1,065	...	...
Mixed hay (other), second cutting†	(6)	4	Tons	...	...	...	...
Timothy	175	256	Tons	15	175	...	...
Rowen†	(15)	15	Tons	...	...	...	...
Rowen fed green†	(14)	7	Tons	...	...	...	...
Potatoes	115.65	8,647	Bushels.	2,554	2,228	273	230
Cabbage	39	283	Tons	94 5	732	6.5	17
Cabbage refuse	...	18	Tons	...	...	...	...
Factory peas†	(5)	33	Hundred-weight.	33	115	...	...
	105.3	1,195	Hundred-weight.	1,195	4,119	...	...
Market peas	151.5	12,205	Bushels.	11,322	17,973	883	1,188
Peavines, cured	...	25	Tons	...	...	...	...
Peavines, green	...	28.5	Tons	...	...	...	...
Field beans	12	132	Bushels.	118.5	567	1.5	8
String beans	9 5	500	Bushels.	500	780	...	...
Hops	3	...	...	...	...	...	...
	25	4,600	Pounds.	1,600	288	...	...
Beets and carrots	1	9	Tons	...	...	...	...
Pumpkins†	(4)	11	Tons	11	40	...	...
	2	24	Tons	24	120	...	...
Apples, young trees†	(12)	...	...	...	...	...	...
Apples, bearing ‡	157	...	Barrels.	829	2,134	9	70
Cherries	2.5	...	...	...	390	...	...
Raspberries	(1)	...	...	...	90	...	...
1921 alfalfa sold	...	...	...	16	165	...	...
Total	6,776.45	...	...	...	$57,728	...	$1,823

* Seven acres of sweet corn were pastured, and no yield was obtained.
† Acres in parenthesis are not included in total acres of crops.
‡ Most of the orchards of this area consisted of scattered trees, and the yields were not ascertained.

crop area in 1921, 12 per cent was in corn for the silo and 46 per cent in alfalfa hay. The tendency is to increase the acreage of alfalfa and of corn to comprise a large proportion of the total area. In 1921, 58 per cent of the acres of crops was in corn for the silo and alfalfa hay. In 1922, 63 per cent of the acreage of crops was in these two enterprises, the largest increase coming from alfalfa.

The average yields per acre and the disposal of each of the cuttings of alfalfa were as shown in table 14:

TABLE 14. PRODUCTION AND DISPOSAL OF ALFALFA

	Number of acres grown	Total yield	Yield per acre	Amount sold	Fed to cows		Per cent of crop		
					Pasture period	Winter period	Fed to Cows	Fed to Other stock	Sold
		Tons of alfalfa							
Crop cured, 1921:									
First cutting...	3,657	5,806	1.6	982	60	2,762	52.4	30.2	17.4
Second cutting.	3,214	3,281	1.0	1,063	72	1,722	55.4	11.9	32.7
Third cutting..	640	482	0.8	28	35	374	85.7	8.4	5.9
Fourth cutting	10	6	0.6	...	......	6	100.0	......	......
Crop fed green, 1921:									
First cutting...	16	67	4.2	......	67	......	100.0	......	......
Second cutting.	292	574	2.0	......	554	17	99.5	0.5	......
Third cutting..	567	828	1.5	......	814	......	98.3	1.7	......
Fourth cutting.	3	4	1.3	......	4	......	100.0	......	......
Crop cured, 1922:									
First cutting...	3,366	5,772	1.7	947	36	2,965	54.1	28.6	17.3
Second cutting.	2,671	2,368	0.9	821	110	1,258	58.4	6.5	35.1
Third cutting..	252	166	0.7	48	13	94	65.2	5.5	29.3
Fourth cutting.	None...	.....	.....	......	......	......	......	......	......
Crop fed green, 1922:									
First cutting...	7	14	2.0	......	14	......	100.0	......	......
Second cutting.	211	362	1.7	......	362	......	100.0	......	......
Third cutting..	375	398	1.1	......	398	......	100.0	......	......
Fourth cutting.	None..	......	......	......	......	......	......	......	......

The average total yield from 3673 acres of alfalfa in 1921 was 2.6 tons of cured hay per acre and 0.4 ton of green hay per acre. In 1922 the average yield from 3373 acres was 2.5 tons of cured hay and 0.2 ton of green hay.

The yield of alfalfa cured in 1921 was 1.6 tons per acre of first cutting, 1.0 ton per acre of second cutting, and 0.8 ton per acre of third cutting. In 1922 the yield per acre of cured alfalfa was 1.7 tons of first cutting, 0.9 ton of second, and 0.7 ton of third.

The yield in 1921 of alfalfa fed green averaged 4.2 tons per acre of first cutting, as fed, 2.0 tons of second cutting, and 1.5 tons of third. In 1922 the yields of the crop fed green were 2.0 tons of first cutting, 1.7 tons of second cutting, and 1.1 tons of third.

The rainfall in May and June, 1921, was only about two-thirds of the normal amount for this region. The first cutting of alfalfa yielded one-tenth of a ton less per acre than it did in 1922, when the rainfall was normal for May but two and one-fourth times the normal for June. The yield

of the second cutting in 1922 was less than it had been in 1921, as July, 1922, in that region was very dry; the rainfall in that month was one-half of normal. The yield of the third cutting was also less than it had been in 1921.

One-half of the first cutting is fed to the cows and one-sixth is sold. Relatively twice as much of the second crop is sold as of the first, and also a larger proportion of the second cutting is fed to cows than of the first. This means that the first crop is used more for young cattle and horses than is the second or the third cutting. A large proportion of the third cutting is fed to cows.

The proportion of the acreage in alfalfa that was harvested and fed green or cured, and the proportion that was not harvested, are shown for the two years in table 15. Of the acres harvested twice, three times, and four times in each season, the proportion used as cured hay and the proportion fed green are also shown in table 15:

TABLE 15. PROPORTION OF ACREAGE OF ALFALFA HARVESTED EACH TIME

Year	1921			1922		
Acreage in alfalfa	3,673			3,373		
	Per cent of total area of crop			Per cent of total area of crop		
	Harvested		Not harvested	Harvested		Not harvested
	Cured	Fed green		Cured	Fed green	
First cutting	99.6	0.4	....	99.8	0.2	....
Second cutting	87.5	8.0	4.5	79.2	6.2	14.6
Third cutting	17.4	15.4	67.2	7.5	11.1	81.4
Fourth cutting	0.3	0.1	99.6	......	......	100.0
Of acreage harvested second time	91.7	8.3	....	92.7	7.3	....
Of acreage harvested third time	53.0	47.0	....	40.2	59.8	....

In 1921, 88 per cent, and in 1922, 79 per cent, of the acreage of alfalfa was harvested the second time and cured. In 1921, 4.5 per cent of the acreage, and in 1922, 14.6 per cent of the acreage, was not harvested the second time. In 1921, 67.2 per cent of the acreage, and in 1922, 81.4 per cent of the acreage, was not harvested the third time. The dry July in 1922 was the cause of lower yields of second and third crops. The lack of rainfall and the labor shortage also resulted in a larger proportion of the acreage not being harvested in the second year.

Of all the acreage harvested the second time, 92 per cent was cured in 1921 and 93 per cent in 1922. The remainder was fed green. Of the acreage harvested the third time, 53 per cent in 1921, and 40 per cent in 1922, was cured, and the remainder was fed green. A larger proportion of the third cutting was fed green in 1922 than in 1921. This was due to

a dry July resulting in short pasture which made more supplementary feed necessary, and a wet August which made it more difficult to cure the part of the third cutting that was made during that month. In this area, 53 per cent of the milk in 1921, and 50 per cent in 1922, was produced in the six months from November to April inclusive. This is a larger proportion of winter production than was found in any of the other regions previously reported, and is due to a greater tendency toward fall freshening, which in turn is encouraged by the use of high-quality alfalfa roughage.

The average yields per acre in 1921 and 1922, respectively, were: corn for the silo, 11.9 and 9.6 tons; oats, 33 and 28 bushels; mixed hay (clover), 1.5 and 1.9 tons; potatoes, 107 and 75 bushels; and market peas, 114 and 81 bushels. As a whole, crop yields were lower in 1922, but hay yielded more than in the previous year. The data are given in table 16:

TABLE 16. AVERAGE YIELDS PER ACRE FOR IMPORTANT CROPS

Kind of crop	Unit	Crop year 1921, yield per acre	Crop year 1922, yield per acre
Corn for the silo	Tons	11.9	9.6
Oats for grain	Bushels	32.6	28.3
Oats for hay	Tons	1.5	1.3
Winter wheat	Bushels	23.2	19.7
Alfalfa cured, first cutting	Tons	1.6	1.7
Alfalfa cured, second cutting	Tons	1.0	0.9
Alfalfa cured, third cutting	Tons	0.8	0.7
Alfalfa cured, fourth cutting	Tons	0.6	....
Mixed hay (clover)	Tons	1.5	1.9
Mixed hay (other)	Tons	1.0	1.4
Timothy	Tons	1.4	1.5
Potatoes	Bushels	106.7	74.8
Cabbage	Tons	7.6	7.3
Factory peas	Hundredweight	14.5	11.2
Market peas	Bushels	114.0	80 6

The crop index for all crops, compared with the average yields in New York as 100, was 100 for 1921 and 98 for 1922. The index for corn for the silo was 192 in 1921 and 155 in 1922, and for oats 98 in 1921 and 85 in 1922. When the indexes for corn for the silo, oats threshed, and alfalfa and other hay, are weighted according to the work units spent on each crop, the weighted crop index is 113 for 1921 and 108 for 1922.

The varieties as stated by the farmers, and the acreage of each variety of corn grown for the silo each year, are shown in table 17. There appears to be a tendency to shift from Leaming, Luce's Favorite, Eureka, and Pride of the North, to Sweepstakes, Early Wonder, and Cornell 11. Probably these last three varieties are as well suited to the conditions as any—the first two for the valley and first-rise locations, and the Cornell 11 for higher farms. It is a mistake to plant such types as Eureka on hill farms, where planting is later, frosts are earlier, and the soil is not so well adapted to the production of corn.

TABLE 17. SUMMARY OF VARIETIES OF CORN FOR THE SILO

Varieties	112 farms, 1921		96 farms, 1922	
	Acres	Per cent	Acres	Per cent
Leaming	238.5	24.9	166	18.6
Luce's Favorite	171	17.8	120	13.4
Sweepstakes	134	14.0	185	20.6
Eureka	95.5	10.0	74	8.3
Pride of the North	91.5	9.6	71.5	8.0
Early Wonder	43	4.5	66	7.4
White Cap Yellow Dent	41.5	4.3	48	5.4
Iowa Gold Mine	29	3.0	13	1.5
Early Mastodon	18	1.9	15	1.7
Bloody Butcher	16	1.7	10.5	1.2
90-Day Dent	12.5	1.3	21	2.3
Yellow Dent	9.5	1.0	1	0.1
Cuban Giant	7	0.7	10	1.1
Northwestern Dent	7	0.7	.....	.....
90-Day Wonder	7	0.7	.....	.....
Giant White Cap	6	0.6	12	1.3
Pennsylvania White	6	0.6	6	0.7
Big Crop	6	0.6	.....	.....
Dibble's White	4.5	0.5	.....	.....
Wisconsin No. 7	4	0.4	3	0.3
State	5	0.5	.....	.....
Hall's Gold Nugget	2	0.2	.....	.....
"376"	2	0.2	.....	.....
Dibbles Drought Proof	1.5	0.2	.....	.....
Early Gleaner	1	0.1	.....	.....
Mammoth Red Dent	.....	.....	1	0.1
Virginia Sweet	.....	.....	18	2.0
Cornell No. 11	.....	.....	26	2.9
Genesee Valley Flint	.....	.....	8	0.9
Longfellow	.....	.....	6	0.7
Kinds not found	.....	.....	13	1.5
Total	959	100.0	894	100.0

The dimensions of 122 silos on the farms included in the survey for the crop year 1921 are shown in table 18. Of the 125 farms, 112 had silos, 20 having two each, and 1 having three. In addition to 122 cylindrical silos, there were twelve rectangular silos. The most common sizes were 12 x 24 feet, 14 x 28 feet, and 16 x 30 feet. About an equal number are 12 feet and 16 feet in diameter, and a few more than either of these dimensions are 14 feet in diameter. Of the 134 silos, 23 were more than 30 feet in height.

In 1919, 39 per cent of the entire acreage in corn and other silage crops in the State was corn for grain, 21 per cent was corn cut for forage, and 40 per cent was silage crops, chiefly corn for the silo. The State average for all farms was 1.7 acres of silage crops per farm. The highest yield per acre was 13.5 tons in Cortland County, and the lowest was 5.4 tons in Hamilton County The state average was 9.6 tons per acre

TABLE 18. SUMMARY OF NUMBER OF SILOS OF EACH SIZE, 112 FARMS*

Height in feet	Diameter in feet										Total silos
	11	12	12.5	13	14	14.5	15	16	18	21	
	Number of silos										
20					1						1
22		1	1								2
23		1									1
24		11		1	8			1			21
26		3		3	6			1			13
27		1									1
28		4		1	16	1		6	3		31
30	1	9			4		2	10	3	1	30
31					1						1
32		1			2			3			6
33					1			3			4
34					1				1		2
36		1			1			3	2		7
37								1			1
38					1						1
Total	1	32	1	5	42	1	2	28	9	1	122

* 112 farms had silos, 20 having two each, and 1 having three silos. In addition to the round silos there were also: one silo, 12 x 12 x 20 feet; one silo, 14 x 14 x 22 feet; one silo, 14 x 14 x 16 feet; two silos, 12 x 14 x 30 feet; one silo, 20 x 20 x 28 feet; two silos, 14 x 14 x 26 feet; one silo, 11 x 11 x 28 feet; one silo, 12 x 12 x 34 feet; one silo, 12 x 12 x 14 feet; one silo, 12 x 12 x 24 feet.

LIVESTOCK

Statements of the inventories, purchases, sales, and deaths, of cattle and other livestock for each of the crop years 1921 and 1922, appear in tables 19 to 22.

The average numbers of the more important animals per farm were as follows: in 1921, cows, 19.0, heifers one year old and over, 4.1, heifers under one year, 3.4, bulls, 0.9, horses, 3.9, chickens, 56; in 1922, cows, 19.0, heifers one year old and over, 4.5, heifers under one year, 3.5, bulls, 0.9, horses, 3.9, chickens, 55.

The total number of animal units per farm was 28.7 in 1921 and 28.0 in 1922. In 1921, of the cows on hand at the end of the year, 81 per cent were grades; of the heifers on hand at the end of the year, 69 per cent were grades; of the bulls, 32 per cent were grades. Most of the animals were of the Holstein breed. In 1922, 83 per cent of the cows, 72 per cent of the heifers, and 44 per cent of the bulls, were grades.

The appreciation on cattle per farm was $302 in 1921 and $250 in 1922. The depreciation on horses was 9.6 per cent of their average value in 1921, and 14.7 per cent of it in 1922. This amounts to $52 per farm in 1921 and $76 per farm in 1922.

TABLE 19. APPRECIATION AND DEPRECIATION ON CATTLE, 125 FARMS IN 1921

	Cows						Heifers											
	Grade			Purebred			Grade						Purebred					
							One year or over			Under one year			One year or over			Under one year		
	Number of farms	Number of cows	Value	Number of farms	Number of cows	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value
On hand May 1, 1921	117	1,918	$170,800	50	414	$65,999	81	362	$16,458	71	259	$5,115	32	131	$11,175	30	137	$7,055
Purchased during year	33	152	12,907	6	28	5,200	12	23	1,548	6	14	303	1	4	500	6	26	1,335
Born during year										82	310	1,062				34	138	2,734
Heifers that became cows	78	249	19,320	28	93	10,765												
Total			$203,027			$81,964			$18,006			$6,480			$11,675			$11,124
Sold	75	311 8	$ 24,104	15	59.5	$ 7,694	7	24	$ 1,469	6	15	$ 246	4	15	$ 1,634	9	20	$1,032
Died or killed by accident	27	42		8	13*	200	3	3		1	3		2	2				
Hides sold	9	9	22	1	1	3	3	3	8									
Heifers that became cows							78	249	19,320				28	93	10,765			
Used for food	12	12.2	575	3	2.5	117	2	1	34									
On hand May 1, 1922	117	1,953	171,730	52	460	73,560	83	369	17,255	82	304	6,093	36	166	15,399	36	140	7,929
Total			$196,431			$81,574			$38,086			$6,339			$27,798			$8,961
Appreciation							$33,899											
Depreciation	$6,986																	

* Includes one killed by lightning, indemnity $200.

TABLE 19 (*concluded*)

	Herd bulls						Veals			Bull calves to be sold		
	Grade			Purebred								
	Number of farms	Number of bulls	Value	Number of farms	Number of bulls	Value	Number of farms	Number of veals	Value veals	Number of farms	Number of bull calves	Value
On hand May 1, 1921	26	30	$1,086	76	82.95	$8,885	....	....	....	6	9	$360
Purchased during year	9	9	309	19	17.5	702	1	6	$ 18	1	2	20
Born during year	9	9	35	5	5	63	123	1,720	4,040	10	13	106
Heifers that became cows	....	....	....	....	....	....	....	....	....	....	....	....
Total	....	....	$1,430	....	....	$9,650	....	....	$4,058	....	....	$486
Sold	13	12.5	$ 551	30	28.7	$1,729	121† 117 / 28	1,596 / 123	$3,770 / 1,534	6	12	$435
Died or killed by accident	....	....	....	....	....	....	....	....	....	....	....	....
Hides sold	....	....	....	1	1	4	....	....	....	....	....	....
Heifers that became cows	....	....	....	....	....	....	....	....	....	....	....	....
Used for food	....	....	....	1	0.5	25	4	7	117	....	....	....
On hand May 1, 1922	34	35.5	1,291	66	76.25	8,337	....	....	....	10	12	560
Total	....	....	$1,842	....	....	$10,095	....	....	$5,421	....	....	$995
Appreciation						$857			$1,363			$509
Depreciation	....	....	....	....	....	....	....	....	....	....	....	....

† 28 farms sold 123 fat veals and 117 farms sold 1596 veals at birth.

TABLE 20. SUMMARY OF LIVESTOCK OTHER THAN DAIRY CATTLE, 125 FARMS IN 1921

	Inventory at beginning of year			Purchases			Sales			Inventory at end of year			Died		Used for food		
	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Number of farms	Number of head	Value
Horses	124	476	$69,205	27	44	$6,993	18	27	$2,800	125	487	$67,230	11	11*	. .	. . . .	. .
Colts	14	24	1,905	2	2	115	. . . .	. .	. . .	13	22	2,490	. . . .	. . . .	. . . .	. . . .	. . . .
Mules	1	2	150	. . . .	. . . .	. . .	. .	.	. . .	1	2	150	. . . .	. . . .	. . . .	. . .	.
Stallions	2	2	600	. . . .	. . . .	. . .	. . .	.	. . .	2	2	600	. . . .	. . . .	. . . .	. . .	. . .
Ponies	1	1	20	. . . .	. . . .	. . . .	. .	. . .	. .	1	1	20	. . . .	. . . .	. . .	. . . .	. . .
Sheep, ewes	16	296	2,679	2	11	92	5	21	155	16	290	2,523	3	5†	. .	. . . .	. . . .
Sheep, bucks	8	8	127	2	2	13	3	3	18	7	12	172	1	1	. .	. . .	. . .
Lambs, weaned	2	24	120	. . . .	. . .	. . . .	13	153	1,173	5	72	434	3	12	1	5	$ 50
Brood sows	22	37	1,262	3	3	55	5	7.5	239	15	28	915	. . . .	. . . .	8	12	256
Other hogs	24	60	820	14	41	405	17	94	1,190	34	80	1,213	3	3	59	114	3,554
Pigs weaned	7	42	211	37	94	522	8	107	529	4	39	227	1	1	. . . .	. . . .	. . . .
Chickens	120	6,859	7,546	8	356	313	38	1,639	1,734	121	7,127	7,584	. . . .	. . . .	. . . .	. . . .	. . . .
Baby chicks	. . . .	. . . .	. . . .	4	587	77	. . .	. . .	. . . .	. . . .	. . . .	. . .	. . . .	. . . .	. . . .	. . . .	. . .
Turkeys	6	27	138	1	2	6	4	31	101	8	32	163	. . . .	. . . .	. . . .	. . . .	. . . .
Geese	5	22	71	1	4	16	1	3	8	5	23	75	. . . .	. . . .	. . . .	. . . .	. . .
Guinea hens	2	7	4	. . . .	. . . .	.	1	10	5	5	16	10	. . . .	. . . .	. . . .	. . .	. . .
Ducks	13	179	256	. . .	. . .	. . . .	5	82	137	14	202	294	. . . .	. . .	. . . .	. . .	. . .
Total	. . . .	. . . .	$85,114	. . . .	. . .	$8,607	. . . .	. . . .	$8,089	. . .	. . . .	$84,100	. . . .	. . . .	. . . .	. . .	$3,860

* One horse hide sold for $3.
† Includes one killed by dog, indemnity $10.

TABLE 21. APPRECIATION AND DEPRECIATION ON CATTLE, 108 FARMS IN 1922

	Cows						Heifers											
	Grade			Purebred			Grade						Purebred					
							One year or over			Under one year			One year or over			Under one year		
	Number of farms	Number of cows	Value	Number of farms	Number of cows	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value
On hand May 1, 1922	101	1,692	$149,196	41	373	$59,425	72	344	$15,780	75	286	$5,481	28	129	$11,895	27	99	$5,951
Purchased during year	37	134	11,409	8	26	3,555	5	22	857	6	15.5	174	2	17	1,320	3	6	115
Born during year	...	...	...	...	...	...	...	...	...	73	256	882	...	...	...	31	119	2,421
Heifers that became cows	63	240	16,030	16	68	8,265	...	...	...	...	...	...	...	...	...	...	...	...
Total	...	...	$176,635	...	...	$71,245	...	...	$16,637	...	...	$6,537	...	...	$13,215	...	...	$8,487
Sold	73	311.5	$20,446	19	92	$12,172	10	32	$ 1,390	4	9.5	$ 115	7	32	$ 3,200	4	19	$1,155
Died or killed by accident	35	56	...	13	20	...	8	9	...	9	12	...	2	2	...	2	3	...
Hides sold	10	12	51	1	1	5	1	1	4	...	...	...	...	...	...	...	...	...
Heifers that became cows	...	...	...	...	...	...	63	240	16,030	...	...	...	16	68	8,265	...	...	...
Eaten	11	9.5	433	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
On hand May 1, 1923	101	1,689	151,625	43	355	56,005	77	364	17,080	74	257	5,164	29	140	14,164	30	106	5,045
Total	...	...	$172,555	...	...	$68,182	...	...	$34,504	...	...	$5,279	...	...	$25,629	...	...	$6,200
Appreciation	...						$26,736											
Depreciation	$7,143						...											

TABLE 21 (*concluded*)

	Herd bulls						Veals			Bull calves to be sold		
	Grade			Purebred								
	Number of farms	Number of bulls	Value	Number of farms	Number of bulls	Value	Number of farms	Number of veals	Value	Number of farms	Number of bull calves	Value
On hand May 1, 1922	35	35	$1,478	55	66 25	$7,133		. . .		3	4	$ 95
Purchased during year	15	16	545	14	14	999				1	1	100
Born during year	11	13	53	9	10	203	107	1,431	$3,514	3	5	118
Heifers that became cows												. . .
Total			$2,076			$8,335			$3,514			$313
Sold	19	18 5	$ 819	29	30 5	$1,861	107* {104 14}	1,362 65	$3,522 845	5	6	$385
Died or killed by accident				2	2			. . . .				
Hides sold	1	1	4	3	2	10						
Heifers that became cows												
Eaten	2	1 5	73	2	1	63	2	4	30			
On hand May 1, 1923	36	44	1,750	51	56 75	4,887				3	4	160
Total			$2,646			$6,821			$4 397			$545
Appreciation									$883			$232
Depreciation			$944									

* 14 farms sold 65 fat veals and 104 farms sold 1362 veals at birth.

TABLE 22. SUMMARY OF LIVESTOCK OTHER THAN DAIRY CATTLE, 108 FARMS IN 1922

	Inventory at beginning of year			Purchases			Sales			Inventory at end of year			Died		Used for food		
	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Number of farms	Number of head	Value
Steers	1	2	$ 70	...	...	...	...	...	...	1	2	$ 140	...	...	...	...	...
Horses	108	415	57,755	27	36	$5,276	20	27	$2,820	108	413	53,071	20	21	...	...	...
Colts	11	20	1,915	1	1	75	1	1	50	7	9	895	1	1	...	...	...
Mules	2	4	400	...	...	...	...	...	...	2	1	325	...	...	...	...	...
Stallions	2	2	600	...	...	...	...	...	...	2	2	550	...	...	...	...	...
Ponies	2	2	120	...	...	...	...	...	...	2	2	120	...	...	...	...	...
Sheep, ewes	12	218	2,062	...	...	...	6	46	321	12	195	1,896	5	28	...	...	...
Sheep, bucks	5	10	180	3	3	47	4	8	127	4	1	67	1	1	...	...	...
Lambs, weaned	2	55	310	1	2	2	11	156	1,250	5	10	281	...	...	...	...	...
Brood sows	12	18	501	4	4	76	2	1.5	79	17	23	731	2	2	3	3.5	$ 139
Boars	1	1	25	1	1	20	1	1	10	1	1	25	...	...	...	...	...
Other hogs	23	51	737	15	40	253	9	24.5	601	32	66	1,166	2	2	33	66.5	1,943
Pigs, weaned	1	3	30	23	45	273	8	91	509	7	25	184	...	...	...	...	...
Chickens	103	5,746	6,186	3	185	207	32	1,583	1,276	104	6,230	6,791	...	...	...	...	...
Baby chicks	1	150	75	3	775	102	...	...	...	1	300	55	...	...	...	...	...
Turkeys	2	10	75	...	...	...	2	11	68	2	21	105	...	...	...	...	...
Geese	5	40	157	...	...	...	4	45	266	4	81	192	...	...	...	...	...
Guinea hens	1	2	2	...	...	...	...	...	...	1	2	2	...	...	...	...	...
Ducks	9	117	160	...	...	...	4	52	110	11	86	120	...	...	...	...	...
Total	...	...	$71,360	...	...	$6,331	...	...	$7,437	...	...	$66,716	...	...	...	...	$2,082

MILK SOLD

The receipts from milk sold each year are shown in tables 23 and 24. In 1921, 62 per cent of the farmers sold 9.8 million pounds, or 66 per cent, of the milk from all the 125 farms through the Dairymen's League Cooperative Association, Inc., and received the pool prices of this Association. The remaining 38 per cent of the farmers sold 5.0 million pounds of milk directly to the dealers. In 1922, 56 per cent of the farmers sold 6.7 million pounds, or 54 per cent, of the milk from 108 farms through the Dairymen's League Cooperative Association, Inc. The remaining 44 per cent of the farmers sold 5.7 million pounds, or 46 per cent of the total, directly to the dealers.

Most of the milk was handled by J. H. Muller at Valley Mills and Munnsville, J. H. Doscher at Pratts Hollow, and August Peiper at Kenwood. A few patrons delivered to the Franklin Creamery at Morrisville, and some to the Middle States Creamery Company at Peterboro and Oneida. During parts of both years, the milk of members of the Dairymen's League Cooperative Association, Inc., was trucked to Vernon. In July, 1922, the arrangement was made with J. H. Muller whereby the milk of both poolers and non-poolers was delivered to his Valley Mills and Munnsville plants.

The monthly distribution of the production of milk, the average milk test, and the monthly receipts per farm from milk sold each year, are given in table 25.

Production was lowest in August, September, and October, altho the monthly distribution was more uniform here than in many other areas.

The butterfat test averaged 3.4 per cent each year. The monthly variation was from 3.3 to 3.5 per cent. The test of milk in this area was lower than in any of the regions reported in the preceding bulletins of this series, and there was no difference between the average test of summer and winter milk.

The average pool price received by the farmer for milk sold thru the Dairymen's League Cooperative Association, Inc. was $2.03 for the year 1921, and the average price received for milk not sold thru that organization was $2.47, or 44 cents more per 100 pounds. The average test of milk was 3.4 per cent for the year. Of the $2.03 received for milk sold thru the pool, 16 cents was in the form of certificates of indebtedness and $1.87 was cash.

The average price received for pooled milk in 1922 was $2.04 per 100 pounds, of which 14 cents was in the form of certificates of indebtedness and $1.90 was cash. For the crop year 1922, the average price received for milk not pooled was $2.38, or 34 cents more per 100 pounds than for milk sold thru the Dairymen's League Cooperative Association, Inc.

A comparison of the index numbers of general prices in the United States, farm prices in the United States and in New York, retail prices of food in cities of the United States, and milk prices at Utica, is made in table 26.

The index numbers in table 26 for milk and for the New York farm prices, which depend to a great extent on the milk index, compare pool prices in recent years with shipping-station prices before 1921. Much other milk is sold by farmers at more than pool prices. Also, the pool price is that price returned to farmers after the costs of operating the cooperative association's own plants are deducted. This means that the outcome of plant operation at once reflects on the price of the milk. When these

TABLE 23. RETURNS FROM MILK SOLD WHOLESALE, 125 FARMS IN 1921

Month	Milk pooled*									Milk not pooled					
	Number of farms selling milk †	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butter-fat	Amount dealer paid for milk	Amount received by farmers for milk: Certificates of indebtedness	Amount received by farmers for milk: Cash	Amount received by farmers for milk: Total	Amount received by farmers for milk: Total per 100 pounds	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butter-fat	Amount dealer paid for milk‡	Amount received by farmer for milk per 100 pounds
1921:															
May (pasture)	....	573,133	19,038	..	$12,185	$ 571	$ 9,413	$ 9,984		...	238,432	8,052	.....	$ 5,030	.....
May (winter)	....	504,653	16,794	.	10,636	507	8,484	8,991	.	....	263,548	8,889	..	5,458	.....
June (pasture)	....	919,455	30,488	...	16,431	931	13,074	14,005	..	...	442,688	14,878	..	8,331	...
June (winter)	....	2,669	85	..	46	3	36	39	..		.....	...		.....	.....
May (total)	82	1,077,786	35,832	3 3	22,821	1,078	17,897	18,975	$1.76	46	501,980	16,941	3.4	10,488	$2 09
June (total)	82	922,124	30,573	3 3	16,477	934	13,110	14,044	1 52	46	442,688	14,878	3.4	8,331	1 88
July	82	711,649	23,629	3.3	14,236	715	11,983	12,698	1 78	46	357,267	12,056	3 4	7,426	2.08
August	83	705,937	23,395	3.3	18,603	1,392	14,189	15,581	2 21	44	330,613	11,434	3 5	9,361	2 83
September (pasture)	....	635,803	21,484	...	17,330	1,262	13,718	14,980	...	.	280,889	9,778	..	8,254	..
Sept. (winter)	....	806	26	....	23	2	17	19	...	..	..	.	...	.....	.....
Oct. (pasture)	....	447,755	15,424	..	14,222	8?6	10,656	11,552	....	.	168,647	5,970	...	5,595	.....
Oct. (winter)	....	262,743	9,040	..	7,872	518	6,170	6,688	...	..	118,585	4,243	.	3,982	...
November (pasture)	....	7,361	235	...	206	15	167	182	..	...	292	9	.	11	....
Nov. (winter)	....	737,151	25,204	..	23,258	1,475	17,451	18,926	.	...	320,554	11,422		10,967	..
Sept. (total)	82	636,609	21,510	3 4	17,353	1,264	13,735	14,999	2 36	44	280,889	9,778	3.5	8,254	2.94
October (total)	81	710,498	24,464	3.4	22,094	1,414	16,826	18,240	2.57	44	287,232	10,213	3.6	9,577	3 33
Nov. (total)	82	744,512	25,439	3 4	23,464	1,490	17,618	19,108	2.57	46	320,846	11,431	3 6	10,978	3 42
December	83	887,706	30,443	3 4	27,019	1,769	20,703	22,472	2.53	48	408,082	14,297	3 5	13,439	3 29
1922:															
January	83	928,644	31,619	3 4	25,897	1,831	18,561	20,392	2 20	48	444,009	15,601	3 5	13,594	3.06
February	80	811,862	27,340	3.4	19,936	1,634	15,266	16,900	2.08	50	431,725	14,796	3 4	11,612	2.69
March	78	912,890	30,461	3.3	15,478	1,824	13,520	15,344	1.68	51	523,983	17,921	3 4	9,455	1 80
April (pasture)	.....	....	....	....	.....	.....	....	......	......	.....	269	9	..	6	..
April (winter)	...	765,413	24,965	.....	11,357	766	9,881	10,647	...	...	680,073	22,680	....	11,111	.....
April (total)	64	765,413	24,965	3.3	11,357	766	9,881	10,647	1.39	63	680,342	22,689	3 3	11,117	1 63
Total:															
Pasture	.....	4,001,093	133,693	3.3	$93,213	$5,782	$73,200	$78,982	$1 97	....	1,819,097	62,186	3.4	$44,014	$2.42
Winter	.....	5,814,477	195,977	3.4	$141,522	$10,329	$110,089	$120,418	$2.07	.....	3,190,559	109,849	3 4	$79,618	$2 50
Year	.....	9,815,570	329,670	3 4	$234,735	$16,111	$183,289	$199,400	$2 03	.....	5,009,656	172,035	3 4	$123,632	$2.47

* Milk pooled was that sold thru the Dairymen's League Cooperative Association, Inc. This milk entered into the league pool, and the producer received the net pool price paid by the association. The amount that the dealer paid represents the money which the local buying companies paid to the cooperative association for milk delivered by members of the association, or paid directly to farmers not affiliated with the cooperative association.

† On some farms operated by tenants, half of the milk was pooled and half was not pooled.

‡ Also received by farmers.

TABLE 24. RETURNS FROM MILK SOLD WHOLESALE, 108 FARMS IN 1922

Month	Milk pooled*									Milk not pooled					
	Number of farms selling milk†	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butterfat	Amount dealer paid for milk	Amount received by farmers for milk: Certificates of indebtedness	Cash	Total	Total per 100 pounds	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butterfat	Amount dealer paid for milk ‡	Amount received by farmer for milk per 100 pounds
1922:															
May (pasture)		402,125	13,362		$ 5,757	$ 403	$ 5,122	$ 5,525			323,060	10,699		$ 5,141	
May (winter)		383,283	12,620		5,405	383	4,841	5,224			261,163	8,659		4,165	
June (pasture)		756,665	24,802		10,928	757	9,847	10,604			544,504	17,959		8,781	
June (winter		1,620	49		20	1	17	18							
May (total)	61	785,408	25,982	3 3	11,162	786	9,963	10,749	$1 37	47	584,223	19,358	3 3	9,306	$1 59
June (total)	63	758,285	24,851	3 3	10,948	758	9,864	10,622	1 40	45	544,504	17,959	3 3	8,781	1 61
July	64	579,474	19,350	3 3	10,002	1,159	8,675	9,834	1 70	44	429,338	14,316	3 3	8,309	1 94
August	65	486,667	16,605	3 4	9,931	727	8,355	9,082	1 87	43	362,069	12,403	3 4	8,739	2 41
September	65	455,287	15,542	3 4	9,946	681	8,834	9,515	2 09	44	327,314	11,236	3 4	7,901	2 41
October (pasture)		335,979	11,669		8,150	672	7,143	7,815			265,380	9,223		6,836	
October (winter)		157,614	5,362		3,682	314	3,320	3,634			109,402	3,824		2,818	
November (pasture)		5,161	170		141	11	120	131			5,008	176		141	
November (winter)		471,347	16,196		12,527	944	11,160	12,104			387,329	13,090		10,707	
October (total)	63	493,593	17,031	3 5	11,832	986	10,463	11,449	2 32	46	374,782	13,047	3 5	9,654	2 58
November (total)	61	476,508	16,366	3 4	12,668	955	11,280	12,235	2 57	48	392,337	13,266	3 4	10,848	2 77
December	60	539,023	18,449	3 4	16,086	1,079	14,299	15,378	2 85	49	464,253	15,900	3 4	14,417	3 11
1923:															
January	60	564,656	19,068	3 4	14,834	564	12,421	12,985	2 30	49	530,778	17,936	3 4	15,410	2 90
February	59	504,730	17,605	3 5	12,825	503	11,593	12,096	2 40	49	494,517	16,475	3 3	12,978	2 62
March	59	553,566	18,694	3 4	13,151	553	11,720	12,273	2 22	49	559,151	19,066	3 4	13,804	2 47
April	51	465,560	15,515	3 3	10,720	684	9,238	9,922	2 13	55	635,023	21,472	3 4	15,242	2 40
Total:															
Pasture		3,021,358	101,500	3.4	$54,855	$4,410	$48,096	$52,506	$1 74		2,256,673	76,012	3 4	$45,848	$2 03
Winter		3,641,399	123,558	3.4	$89,250	$5,025	$78,609	$83,634	$2 30		3,441,616	116,422	3 4	$89,541	$2 60
Year		6,662,757	225,058	3 4	$144,105	$9,435	$126,705	$136,140	$2 04		5,698,289	192,434	3 4	$135,389	$2 38

* See first footnote on page 28.

† On one farm operated by a tenant, half of the milk was pooled and half was not pooled for the months September to March inclusive. On one farm no milk was sold during February and March, and on two farms none was sold during April.

‡ Also received by farmers.

TABLE 25. DISTRIBUTION OF MILK PRODUCTION

	125 farms in 1921–22				108 farms in 1922–23			
	Total pounds of milk sold wholesale	Per cent	Butter fat test	Value per farm, including certificates of indebtedness	Total pounds of milk sold wholesale	Per cent	Butter-fat test	Value per farm, including certificates of indebtedness
May	1,579,766	10.7	3.3	$236	1,369,031	11.1	3.3	$180
June	1,364,812	9.2	3.3	179	1,302,780	10.5	3.3	180
July	1,068,916	7.2	3.3	161	1,008,812	8.2	3.3	168
August	1,036,550	7.0	3.4	200	848,736	6.9	3.4	165
September	917,498	6.2	3.4	186	782,601	6.3	3.4	161
October	997,730	6.7	3.5	222	868,375	7.0	3.5	195
November	1,065,358	7.2	3.5	241	868,845	7.0	3.4	214
December	1,295,788	8.7	3.5	287	1,003,276	8.1	3.4	276
January	1,372,653	9.3	3.4	272	1,095,434	8.9	3.4	263
February	1,243,527	8.4	3.4	228	990,247	8.1	3.4	232
March	1,436,873	9.7	3.4	198	1,112,717	9.0	3.4	241
April	1,445,755	9.7	3.3	174	1,100,583	8.9	3.4	233
Total	14,825,226	100.0	3.4	$2,584	12,361,046	100.0	3.4	$2,514
Total pasture	5,820,190	39.3	3.4	...	5,278,031	42.7	3.4	...
Total winter	9,005,036	60.7	3.4	...	7,083,015	57.3	3.4	...

facts are considered, at least the prices paid by companies for milk, and possibly prices actually received by all farmers in the metropolitan milk area, have held as closely as could be expected to general price movements.

TABLE 26. INDEX NUMBERS OF VARIOUS THINGS WHEN THE AVERAGE FOR THE FIVE YEARS FROM 1910 TO 1914 IS TAKEN AS 100 *

Year	General prices in the United States	Farm prices		Retail food prices in cities of the United States	Milk at Utica, 3.7 per cent
		United States	New York		
1920	231	214	217	209	220†
1921	150	119	144	158	155‡
1922	152	124	134	146	133‡
1923	157	137	142	151	150‡

* Prepared by G. F. Warren and published in *Farm Economics*.
† Shipping-station price.
‡ Pool price.

Another factor which must be considered but which has been given little consideration in price trends, is weather conditions. The July, August, and September rainfall in western and central New York for the past eleven years, for example, has averaged 4.5 per cent above the long-time normal. Of these, seven have been wet years, with two years, 1915 and 1924, the wettest in thirty-five years. The production as influenced by weather must always be considered in relation to the position of an industry as to relative price.

MISCELLANEOUS RECEIPTS

The miscellaneous farm receipts for two years are given in table 27. The largest sources of miscellaneous income are eggs, outside labor, and maple sirup. The income from all miscellaneous sources amounted to $131 per farm in 1921 and $134 per farm in 1922. On some farms, the opportunity to increase the income in such ways is neglected.

TABLE 27. MISCELLANEOUS FARM RECEIPTS

	125 farms in 1921					108 farms in 1922				
	Amount	Price	Value			Amount	Price	Value		
			Farm	Operator	Landlord			Farm	Operator	Landlord
Human labor off farm	514 days	$16.51	$3,345	$3,345		366 days	$3.87	$1,418	$1,418	
Horse labor off farm	340 days	1.56	530	530		220 days	2.73	600	600	
Use of machinery			690	600		19 days	13.42	255	255	
Rent of house	12 months	10.00	120	120				120	120	
Use of pasture			310	294	$16			150	150	
Maple sirup	557 gallons	2.10	1,170	1,145	25	449 gallons	2.15	964	964	
Maple sugar								5	5	
Lumber	8 thousand feet	36.88	295	295		9 thousand feet	32.22	290	290	
Wood, standing								950	950	
Wood, cut	117 cords	2.35	275	269	6	33 cords	6.09	201	196	$5
Cedar posts	1,200 posts	0.15	180	180		700 posts	0.15	105	105	
Wool	1,858 pounds	0.23	432	432		1,165 pounds	0.30	353	353	
Eggs	25,363 dozen	0.31	7,876	7,554	322	19,923 dozen	0.31	6,245	6,121	124
Feed bags	3,397	0.04	125	117	8	3,560	0.03	108	108	
Hauling milk			120	120						
Breeding fees			434	434				50	50	
Board of horses and cattle			20	20				85	85	
Ice						4,480 cakes	0.05	224	224	
Premiums at fair			90	90						
Manure						104 tons	0.91	95	95	
Hides	44	1.41	62	60	2	55	2.29	126	126	
Indemnity on sheep and cows			10	10				103	100	3
Insurance on cows, buildings, and equipment	1		200	200				1,600	1,600	
Other items			60	60				401	397	4
Total			$16,344	$15,965	$379			$14,448	$14,312	$136

FARM EXPENSES

In 1921 the current operating expenses per farm were $2896, of which 21.2 per cent was for cattle and horse feed, 35.1 per cent was for labor, 5.7 per cent for taxes, and 38.0 per cent for other items (table 28). The

TABLE 28. FARM EXPENSES

	125 farms in 1921			108 farms in 1922		
	Value			Value		
	Total	Per farm	Per cent	Total	Per farm	Per cent
Labor, hired	$62,702	$502	17.3	$44,676	$414	15.7
Labor, unpaid	48,643	389	13.5	40,664	377	14.3
Board of hired labor	15,473	124	4.3	14,724	136	5.2
Horse labor hired	....	....	....	340	3	0.1
Advertising	148	1	....	211	2	0.1
Bedding	507	4	0.1	251	2	0.1
Baling	1,828	15	0.5	268	2	0.1
Barrels, baskets, bags	3,789	30	1.0	1,729	16	0.6
Breeding fees	376	3	0.1	29	....	....
Building repairs, roofing, paint	10,163	81	2.8	5,001	46	1.7
Water system	98	1	....	450	4	0.2
Furnace	....	....	....	65	1	....
Salt	1,524	12	0.4	922	9	0.3
Poultry, sheep, and hog feed	3,898	31	1.1	4,146	38	1.4
Skimmilk purchased	75	1	....	200	2	0.1
Pasturage	1,630	13	0.5	667	6	0.2
Commissions, storage	3,119	25	0.9	1,567	15	0.6
Freight, express, cartage	5,868	47	1.6	3,846	36	1.4
Drains	668	5	0.2	689	6	0.2
Hay, silage, stalks, straw	2,382	19	0.7	1,499	14	0.5
Cattle and horse feed	76,575	613	21.2	65,235	604	23.0
Grinding feed	1,159	9	0.3	679	6	0.2
Fence, wire, post, staples	2,887	23	0.8	1,403	14	0.5
Fertilizer	5,909	47	1.6	4,484	42	1.6
Lime	....	....	....	85	1	....
Manure	....	....	....	20	....	....
Horseshoeing	6,134	49	1.7	4,201	39	1.5
Insurance	4,734	38	1.3	4,164	39	1.5
Sawing lumber	1,012	8	0.3	310	3	0.1
Machinery, new	21,408	171	5.9	16,547	153	5.8
Repairs on machinery	7,877	63	2.2	3,936	36	1.4
Machines, hired	433	4	0.1	584	5	0.2
Filling silo	3,793	30	1.0	2,907	27	1.0
Threshing	2,808	23	0.8	1,783	16	0.6
Tractor plowing	....	....	....	10	....	....
Cutting corn	....	....	....	21	....	....
Coal, oil, gasoline for farm use	4,936	40	1.4	2,846	26	1.0
Twine	1,321	11	0.4	800	7	0.3
Farm share of upkeep and operation of automobile	8,964	72	2.5	9,701	90	3.4
Ice, and sawdust for ice	731	6	0.2	323	3	0.1
Hauling milk	1,907	15	0.5	420	4	0.2
Milk bottles, cans, strainers	1,011	8	0.3	465	4	0.2
Cow tester, acid, fees	156	1	....	463	4	0.2
Registration fees	379	3	0.1	164	2	0.1
Grass seed	5,695	46	1.6	4,657	43	1.6
Other seeds, plants, trees	6,657	53	1.8	5,482	51	1.9
Spray materials	656	5	0.2	498	5	0.2
Syrup cans	19	....	....	....	....	....
Rent for milk cans	420	3	0.1	276	3	0.1
Silo rented	50	....	....	....	....	....
Hop expenses, except labor	1,433	12	0.4	48	....	....
Electricity and carbide	180	1	....	210	2	0.1
Stamps, stationery, for farm use	99	1	....	125	1	....
Telephone toll, farm use	1,602	13	0.5	1,765	16	0.6
Land taxes } School taxes }	20,789	166	5.7	13,453	125	4.7
				5,804	54	2.1
Veterinary, medicine	2,455	20	0.7	2,139	20	0.8
Any other farm expenses	4,901	39	1.4	6,215	58	2.2
Total (except cash rent and new buildings	$361,981	$2,896	100.0	$284,221	$2,632	100.0
Cash rent	4,424	....	....	2,510	....	....
New buildings	16,713	134	....	5,099	47	....
Total	$383,118	....	....	$291,830	....	....
Livestock purchased	$31,449	$251	....	$25,405	$235	....

expenditure of $134 per farm for new buildings and of $251 per farm for livestock purchased, makes the total expenses $3281 per farm.

In 1922 the current operating expenses per farm were $2632, of which 23.0 per cent was for cattle and horse feed, 35.2 per cent was for labor, 6.8 per cent for taxes, and 35.0 per cent for all other items. Expenditures for new buildings in 1922 were $47 per farm, or about one-third of the amount in 1921, and the cost of livestock purchased was $235. The total farm-expense average was thus $2914. Taxes amounted to slightly over one-fourth of the feed bill and less than one-fifth of the labor charge. Buying in quantities at times of low prices gives an opportunity to save probably half of the entire amount spent for taxes. In this respect saving is more within the reach of most farmers than is the reduction of taxes.

LABOR INCOMES

The net farm income in this area, that is, the difference between the farm receipts and the farm expenses, was $997 in 1921. The interest on capital of $15,371 in 1921 at 5 per cent was $769, or $228 less than the net farm income. Thus $228 was the average labor income for the 125 farm operators. The net farm income in 1922 was $783. The interest on

TABLE 29. RECEIPTS, EXPENSES, INTEREST, AND LABOR INCOME, IN 1921 AND 1922

	125 farms in 1921			108 farms in 1922		
	Per farm	Per farm as found	Per farm at pool prices	Per farm	Per farm as found	Per farm at pool prices
Capital, average	$15,371	......	......	$15,588	......	.....
Receipts:						
Milk:						
Cash	......	$2,457	$2,209	.....	$2,428	$2,207
Certificates of indebtedness	......	129	193	.....	87	161
Crops sold	.....	801	801	....	551	551
Livestock sold	......	418	418	.....	495	495
Increase in inventory	..	342	342	.....	2	2
Miscellaneous	.....	131	131	.....	134	134
Total receipts	......	$4,278	$4,094	....	$3,697	$3,550
Expenses:						
General expenses	.....	$2,896	$2,896	....	$2,632	$2,632
Livestock purchased	.....	251	251	..	235	235
New buildings and building improvements	....	134	134	.....	47	47
Total expenses	.....	$3,281	$3,281	...	$2,914	$2,914
Farm income (receipts less expenses)	.....	$997	$813	......	$783	$636
Interest on capital at 5 per cent	...	$769	$769	......	$779	$779
Labor income of operator	....	$228	$44	....	$4	-$143

$15,588 at 5 per cent for 1922 was $779, or $4 less than the net farm income. That is, the average labor income for 108 farm operators in 1922 was $4, or $224 less than in the preceding year. (Table 29.) In both years, the labor income was considerably less than the value placed on their time by the farm operators.

Since 34 per cent of the milk in 1921 and 46 per cent in 1922 was not pooled, in order to furnish a fair comparison of labor incomes it was necessary to compute what the labor income would have been if all conditions had remained the same except that pool prices had been received by all farmers. On this basis the labor income in 1921 would have been $44, and in 1922 minus $143. Inasmuch as the income of only those farmers who did not pool their milk would have been affected had all received pool prices, the entire difference would apply to the 48 non-pool farms in 1921 and the 47 non-pool farms in 1922. The decreased income for these farms, therefore, would have been $481 per farm in 1921 and $337 per farm in 1922.

In 1921 the average cash living costs for the 125 families were $357 for food, $190 for clothes, and $204 for all other items, a total of $751 per farm, or $63 per month.

In 1922 the average cash living costs for the 108 families were $320 for food, $165 for clothes, and $164 for all other items, a total of $658 per farm, or $55 per month. The year 1922 was more unfavorable, prices were lower, and the cash living costs were reduced 12 per cent.

The increase in inventory was $342 per farm in 1921 and $2 in 1922. This was made up of an increase in the inventory of feed and supplies of $17 per farm, an increase in the inventory of livestock of $114 per farm, and the balance, $211, increased value of farm due to an expenditure of $134 per farm for new buildings and improvements, and to purchases of machinery. In reality, the entire labor income in 1921 was represented by the increased value of personal property and not in cash.

In 1922 there was a decrease in the inventory of livestock of $48 per farm. The net increase of $2 was therefore due to expenditures for new buildings and other additions to the premises and equipment Altho the income was less in 1922, the expenses were decreased more than the decrease in income.

COSTS AND RETURNS IN PRODUCING MILK

The costs in producing milk are here grouped as follows: concentrates, succulent feed, dry forage, pasture, bedding, labor, hauling milk, use of buildings, use of equipment, interest, depreciation on cows, bull service, and miscellaneous charges. The returns are for milk and milk products, calves born during the year, manure, and miscellaneous returns.

COSTS

Concentrates

The average value of home grown grain was $32.86 in 1921 and $31.84 in 1922. The average cost of purchased concentrates was $38.97 in 1921 and $43.05 in 1922, or $4 per ton more than in 1921. (Tables 30 and 31.)

Of the total pounds of concentrates used by cows in the winter for 1921, 15.4 per cent was gluten feed, and for 1922, 12.1 per cent was gluten feed. Other feeds used in largest quantities were wheat bran, Empire Chief Dairy Feed, distillers' dried grains, ground oats, hominy, oilmeal, and cottonseed meal.

Of the total concentrates used by cattle in 1921, 88.0 per cent was purchased, and in 1922, 92.7 per cent was purchased. The chief kinds of horse feed used were oats and ground oats. Of the total concentrates used by horses in each of the years 1921 and 1922, 22.4 per cent was purchased.

The cost for concentrates per 100 pounds of milk was 48 cents in 1921 and also in 1922. The cost per cow was $30.26 in 1921 and $28.77 in 1922.

Succulent feed

The average of the estimates for the value of corn silage per ton was $5.19 for 1921 and $5.35 for 1922. The average value of all succulent feed, except skimmilk, was $5.32 per ton for 1921 and $5.33 per ton for 1922. (Tables 32 and 33.) Of the total tonnage of succulent feed used by cows in 1921, 20.0 per cent was used during the pasture period, of which the largest amount was second- and third-cutting alfalfa fed green, and 4.2 tons of ensilage per farm in the 1921 pasture period.

Very little attempt is made to store ensilage for use supplementary to pasture. Alfalfa is much superior for this purpose and less expensive

The charges for succulent feed were: in 1921, $25.97 per cow and 42 cents per 100 pounds of milk; in 1922, $22.72 per cow and 38 cents per 100 pounds of milk.

Alfalfa is fed green to cows in the barn or pasture lot as soon as the second growth is ready. Sometimes part of the first crop is used for this purpose This green alfalfa is an excellent soiling crop. The remainder of the second and of the third growths is cured for hay.

In years of heavy summer rainfall, the amount of feed needed to supplement pasture is much less. More alfalfa is cured in such years, and, since the hay crop also is usually better in rainy seasons, the amount of hay available for sale is thereby considerably more.

With a relatively small acreage of pasture land and with a large proportion of it tillable, and with green alfalfa to use supplementary to pasture, it probably pays well in this section to grow a large acreage of corn for the silo so that in the winter a large part of the ration can be made up of corn silage. This permits of the sale of more alfalfa or the use of more of it supplementary to pasture.

TABLE 30. CONCENTRATES USED BY 2375 COWS, 934 HEIFERS, 112 HERD BULLS, AND 484 HORSES, IN 1921

Kind of feed	Total			Cows				Heifers		Bulls		Horses	
				Pasture period		Winter period							
	Amount (cwt.)	Average price per ton	Value	Amount (cwt)	Value	Amount (cwt.)	Value	Amount (cwt)	Value	Amount (cwt)	Value	Amount (cwt)	Value
Home-grown:													
Corn for grain	1,864	$29 01	$ 2,704			942	$1,428	50	$ 73	6	$ 9	866	$ 1,194
Corn for grain from surplus corn for the silo	1,468	29.20	2,143			842	1,136	98	136	13	18	515	853
Corn for grain, 1920	140	32.00	224									140	224
Oats	8,065	33.20	13,386			1,249	2,030	321	522	23	34	6,472	10,800
Oats, 1920	197	32.28	318			21	33					176	285
Oats and barley	1,310	36 32	2,379			504	930	53	96			753	1,353
Oats, barley, and peas	431	38 70	834			100	182	14	28			317	624
Oats, barley, peas, and wheat	113	34.87	197			59	103					54	94
Barley	529	35 01	926	77	$123	372	657	59	104	8	15	13	27
Buckwheat	48	42 08	101			48	101						
Winter wheat	138	35.51	245			93	171					45	74
Rye	48	50.00	120			48	120						
Total home-grown	14,351	$32.86	$23,577	77	$123	4,278	$6,891	595	$959	50	$76	9,351	$15,528
Purchased:													
Cornmeal	2,189	$31 08	$3,402	188	$ 294	1,158	$ 1,783	380	$ 594	80	$124	383	$ 607
Hominy	3,847	31 80	6,117	335	529	2,833	4,512	309	490	44	71	326	515
Corn and oats	748	34.39	1,286	24	40	269	448	16	27	24	41	415	730
Cracked corn	130	35 38	230									130	230
Corn on cob	28	14.29	20			24	17			4	3		
Whole oats	27	38.52	52									27	52
Ground oats	5,273	34 55	9,109	414	713	2,875	4,938	686	1,188	138	238	1,160	2,032
Molasses	30	30 00	45			29	43			1	2		
Beet pulp	78	35.38	138			78	138						
Wheat bran	6,333	31.02	9,823	463	705	4,700	7,298	768	1,167	158	247	244	406
Wheat feed	169	34.20	289	7	10	143	246	10	18	9	15		
Wheat middlings	598	32.24	964	27	40	494	800	59	94	16	27	2	3
Buckwheat feed	108	32.04	173			100	160	6	10	2	3		
Gluten	6,136	39.66	12,168	524	1,040	5,282	10,474	272	535	58	119		
Larro	677	40.35	1,366			677	1,366						
Red Brand Tioga Dairy feed	60	42 00	126			60	126						
Empire Chief Dairy Feed	3,401	43.59	7,412			3,164	6,899	178	386	59	127		
Empire Leader Dairy Feed	476	41.72	993	69	135	396	838	7	14	3	6		
Cornell Ration	910	43.75	1,991	100	221	796	1,740			14	30		
Big Q	60	42.00	126	60	126								
3M	112	43.39	243			112	243						
Cottonseed meal	1,715	54.76	4,636	171	464	1,489	4,023	35	98	19	51		
Oilmeal	2,442	54.09	6,593	225	612	1,842	4,975	312	845	52	136	11	25
Peanut oilmeal	3	46.67	7			3	7						
Calf meal	21	71.43	75					16	62	5	13		

Unicorn	20	52.00	52	13	34	7	18	......	......	......	......	......	....
Union Grains	360	47.56	856	......	......	359	854	......	......	1	2	......	....
Vernon Dairy Feed	46	45.22	104	......	......	40	90	6	14	......	......	......	....
Dewey's Distillers' Dried Grains	112	48.39	271	1	3	106	256	5	12	......	......	......	....
Distillers' dried grains, other brands	3,091	49.58	7,662	184	453	2,773	6,885	106	260	28	64	......	....
Brewers' dried grains	104	35.77	186	7	14	96	170	......	......	1	2	......	....
Total purchased	39,304	$38.97	$76,575	2,804	$5,433	29,915	$59,407	3,172	$5,814	716	$1,321	2,697	$4,600
Total concentrates	53,655	$37.33	$100,152	2,881	$5,556	34,193	$66,298	3,767	$6,773	766	$1,397	12,048	$20,128

TABLE 31. CONCENTRATES USED BY 2066 COWS, 862 HEIFERS, 99 HERD BULLS, AND 418 HORSES, IN 1922

Kind of feed	Total			Cows				Heifers		Bulls		Horses	
				Pasture period		Winter period							
	Amount (cwt.)	Average price per ton	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value
Home-grown:													
Corn for grain	610	$30.13	$ 919	......	......	274	$ 415	......	......	......	......	336	$ 504
Corn for grain from surplus corn for the silo	322	25.71	414	......	......	96	120	......	......	......	......	226	294
Corn for grain, 1921	20	35.00	35	......	......	......	......	......	......	......	......	20	35
Oats	6,126	32.22	9,868	......	......	1,074	1,759	305	$481	2	$3	4,745	7,625
Oats and barley	1,042	31.21	1,626	......	......	232	314	38	66	......	......	772	1,246
Oats and peas	100	25.00	125	......	......	75	94	......	......	......	......	25	31
Oats, barley, peas, spring wheat, and buckwheat	90	40.00	180	......	......	......	......	......	......	......	......	90	180
Barley	274	33.28	456	......	......	67	102	......	......	......	......	207	354
Buckwheat	62	45.16	140	......	......	62	140	......	......	......	......	......	......
Total home-grown	8,646	$31.84	$13,763	......	......	1,880	$2,944	343	$547	2	$3	6,421	$10,269
Purchased:													
Cornmeal	1,627	$38.75	$ 3,152	120	$ 235	1,117	$2,150	92	$ 181	25	$ 49	273	$ 537
Hominy	2,060	40.19	4,140	162	335	1,582	3,174	202	408	32	66	82	157
Corn and oats	168	39.64	333	......	......	......	......	......	......	......	......	168	333
Cracked corn	100	38.40	192	......	......	......	......	......	......	......	......	100	192
Whole corn	18	38.89	35	......	......	......	......	......	......	......	......	18	35
Whole oats	402	36.97	743	......	......	......	......	117	205	3	5	282	533
Ground oats	3,502	37.08	6,493	255	486	2,173	4,064	361	669	88	161	625	1,113
Ground oats and barley	80	40.00	160	......	......	......	......	......	......	......	......	80	160
Molasses feed	320	37.75	604	......	......	280	534	30	52	10	18	......	......
Wheat bran	3,847	30.69	5,904	205	338	3,182	4,866	320	472	75	116	65	112
Wheat middlings	295	38.37	566	......	......	260	499	29	54	6	13	......	......
Wheat feed	5	36.00	9	......	......	5	9	......	......	......	......	......	......
Gluten	3,573	43.30	7,735	231	531	3,172	6,831	118	259	52	114	......	......
Gluten meal	308	54.22	835	......	......	288	781	14	38	6	16	......	......
Cottonseed meal	532	54.74	1,456	46	133	462	1,254	16	45	8	24	......	......
Oilmeal	2,016	53.30	5,373	165	458	1,625	4,345	177	447	40	102	9	21
Calf meal	14	82.86	58	......	......	......	......	14	58	......	......	......	......
Schumacher	398	38.14	759	5	9	328	633	20	37	5	10	40	70
Larro	458	53.62	1,228	58	162	362	960	28	78	10	28	......	......
Empire Chief Dairy Feed	4,510	47.78	10,774	70	168	4,113	9,825	188	445	104	248	35	88
Empire Leader Dairy Feed	30	38.00	57	......	......	30	57	......	......	......	......	......	......
Cornell Ration	200	45.00	450	......	......	200	450	......	......	......	......	......	......
Union grains	440	50.36	1,108	20	50	395	996	15	37	10	25	......	......
Distillers' dried grains	1,005	59.46	2,988	102	295	884	2,637	9	26	10	30	......	......
Brewers' dried grains	124	51.45	319	......	......	116	298	3	8	5	13	......	......
Beats All	220	48.00	528	20	48	180	432	15	36	5	12	......	......

Hollenbeck's Dairy Ration	2,979	45.51	6,779	140	310	2,632	5,992	153	354	54	123	......	......
Summit	275	51.93	714	......	......	240	624	19	49	16	41	......	......
Colton's mixed feed	230	46.96	540	......	......	215	504	10	24	5	12	......	......
Clyde Milk Maker	40	45.00	90	......	......	40	90	......	......	......	......	......	......
Madison Dairy Feed	60	40.00	120	......	......	60	120	......	......	......	......	......	......
G. L. F. Exchange	120	45.00	270	......	......	120	270	......	......	......	......	......	......
G. L. F. Milk Maker	80	44.00	176	30	66	50	110	......	......	......	......	......	......
Red Dog	45	44.89	101	......	......	39	88	4	9	2	4	......	......
Economy Dairy Feed	20	60.00	60	......	......	20	60	......	......	......	......	......	......
Arcady	125	36.00	225	......	......	120	216	......	......	5	9	......	......
Speeder Horse Feed	72	36.94	133	......	......	......	......	......	......	......	......	72	$ 133
Kinds not found	10	56.00	28	......	......	5	14	5	14	......	......	......	......
Total	30,308	$43.05	$65,235	1,629	$3,624	24,295	$52,883	1,959	$4,005	576	$1,239	1,849	$3,484
Total concentrates	38,954	$40.56	$78,998	1,629	$3,624	26,175	$55,827	2,302	$4,552	578	$1,242	8,270	$13,753

TABLE 32. SUCCULENT FEED USED BY 2375 COWS, 934 HEIFERS, AND 112 HERD BULLS, IN 1921

Kind of feed	Total			Cows				Heifers		Bulls	
				Pasture period		Winter period					
	Amount (tons)	Average price	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:											
Corn silage	10,769.5	$ 5.19	$55,899	270	$1,404	9,020.2	$46,815	1,204	$6,251	269.3	$1,398
Corn silage, 1920	281.0	5.19	1,459	256	1,329	25	130	...	...	...	...
Corn, green	263.0	3.98	1,048	257	1,012	...	...	5	30	1	6
Sweet corn	9.0	6.00	54	9	54	...	...	...	...	...	...
Potatoes†	4.4	17.50	77	2	27	2.2	47	...	...	...	...
Cabbage	2.0	5.00	10	...	...	2	10	...	...	...	...
Cabbage refuse	15.0	2.60	39	...	...	15	39	...	...	...	...
Turnips	2.0	5.00	10	...	...	2	10	...	...	...	...
Beets	44.0	8.00	352	...	...	42	336	1	8	1	8
Mangels	20.0	12.60	252	...	...	14	228	6	24	...	...
Buckwheat	31.0	2.00	62	31	62	...	...	...	...	...	...
Peavine refuse	39.0	5.15	201	32	124	7	77	...	...	...	...
Peavines, harvested	5.0	15.00	75	...	...	5	75	...	...	...	...
Alfalfa, first cutting	67.0	6.45	432	67	432	...	...	...	...	...	...
Alfalfa, second cutting	574.5	6.68	3,836	554.5	3,711	17	102	2	15	1	8
Alfalfa, third cutting	828.0	6.46	5,350	814	5,271	...	...	13	72	1	7
Alfalfa, fourth cutting	4.0	9.00	36	4	36	...	...	...	...	...	...
Total home-grown	12,958.4	$5 34	$69,192	2,296.5	$13,462	9,151.4	$47,869	1,231	$6,400	273.3	$1,427
Purchased:											
Skimmilk	32.2	$2.33	$ 75	...	...	...	...	32.2	$75	...	...
Corn silage	80.0	3.38	270	...	...	80	$270	...	...	...	...
Pea silage	4.0	4.25	17	4	$17	...	...	...	...	...	...
Peavines	30.5	2.10	64	15	30	15.5	34	...	...	...	...
Total purchased	146.7	$2.90	$426	19	$47	95.5	$304	32.2	$75	...	...
Total succulent feed	13,105.1	$5.31	$69,618	2,315.5	$13,509	9,246.9	$48,173	1,263.2	$6,475	273.3	$1,427
Total succulent feed except skimmilk	13,072.9	$5.32	$69,543	2,315.5	$13,509	9,246.9	$48,173	1,231	$6,400	273.3	$1,427

* Horses fed 6 tons, value $31.
† Horses fed 0.2 ton, value $3.

TABLE 33. SUCCULENT FEED USED BY 2066 COWS, 862 HEIFERS, AND 99 HERD BULLS IN 1922

Kind of feed	Total			Cows				Heifers		Bulls	
				Pasture period		Winter period					
	Amount (tons)	Average price	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:											
Corn silage	8,473	$ 5.35	$45,338	159	$ 851	7,233.5	$38,702	922	$4,935	158.5	$850
Corn silage, 1921	162	5.35	867	140	749	22	118	....	....	....	....
Alfalfa silage	28	5.00	140	..	....	28	140	....	....	....	....
Corn, green	108	5 31	574	108	574	.....	....	....	....	....	....
Beets and carrots*	9	10.00	90	....	....	8	80	....	....	....	....
Cabbage	167	4.68	781	16	76	151	705	....	....	....	....
Cabbage refuse	18	3.11	56	10	30	8	26	....	....	....	....
Peavine refuse	28.5	4.60	131	28.5	131	....	....	....	....	....	....
Alfalfa, first cutting	14	6.64	93	14	93	....	....	....	....	....	....
Alfalfa, second cutting	362	5.42	1,963	362	1,963	....	....	....	....	....	....
Alfalfa, third cutting	398	5.96	2,372	398	2,372	....	....	....	....	....	....
Rowen	7	4 00	28	7	28	....	....	....	....	....	....
Total home-grown	9,774 5	$5.36	$52,433	1,242.5	$6,867	7,450.5	$39,771	922	$4,935	158.5	$850
Purchased.											
Skimmilk	50	$4.00	$200	....	....	....	....	50	$200	....	....
Corn silage	70	3.21	225	....	....	60	$195	8	24	2	$6
Pea silage	10	2.00	20	....	....	10	20	....	....	....	....
Peavines	44 5	2.00	89	6	$12	38.5	77	....	....	....	....
Total purchased	174.5	$3 06	$534	6	$12	108 5	$292	58	$224	2	$6
Total succulent feed	9,949	$5.32	$52,967	1,248 5	$6,879	7,559.0	$40,063	980	$5,159	160.5	$856
Total succulent feed except skimmilk	9,899	$5.33	$52,767	1,248.5	$6,879	7,559.0	$40,063	930	$4,959	160.5	$856

* Horses fed 1 ton, value $10.

Dry forage

Of the total dry forage used by cows in each year, 1921 and 1922, 90 per cent was alfalfa hay.

The average value of all dry roughage used by cattle and horses in 1921 was $13.87 per ton, and in 1922, $11.67 per ton.

The average prices at which alfalfa was charged to stock in each year are summarized in table 34:

TABLE 34. VALUES PER TON FOR CURED ALFALFA

Cutting	1921	1922
First	$13.22	$10.96
Second	16.23	14.79
Third	16.80	14.94
Fourth	16.00	....

The charges for dry forage in producing milk were: in 1921, $35.07 per cow and 56 cents per 100 pounds of milk; in 1922, $29.44 per cow and 49 cents per 100 pounds of milk. The data for dry forage used in 1921 are given in table 35, and for 1922 in table 36.

Protein and energy used

The use of the nutritive ratio does not allow the protein to be expressed directly on a percentage basis. A more useful index of the relative protein content of rations is the percentage of the digestible nutrients derived from protein or the percentage of the net energy derived from protein. Since protein is ordinarily believed to furnish as much energy per pound as do carbohydrates, the protein-energy ratio is a useful index for this basis; for a P.E. ratio of 1:5.0 indicates at once that one-fifth, or 20 per cent, of the net energy is derived from protein.

The right amount of protein to be fed is now frequently discussed — a fair indication that few are certain of the answer. It is sometimes stated that the use of alfalfa results in the same production as the use of less concentrates, or as less high-protein concentrates, or as both. It appears that farmers using alfalfa hay do neither of these things; they feed as much grain, and grain with as high protein content, as do farmers who use mixed hay, but get more milk. Whether they would get as heavy production per cow or make as high returns for their time by reducing either the amount or the protein content of the concentrates is still a matter of doubt.

The protein-energy ratio of the winter rations of cows was 1:4.9 for 1921, and 1:4.7 for 1922 (table 37). This is much lower than in any area studied by the writer, the lowest found hitherto being in the vicinity of Tully and Homer, where it was 1:6.1.[2] The feed cost per 100 pounds of milk produced was the lowest where alfalfa was used of any area yet studied by the writer, in spite of the fact that the total feed cost per cow was

[2] Economic studies of dairy farming in New York. II. Grade A milk with and without cash crops. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bul. 433, 1924, p. 74.

TABLE 35. DRY FORAGE USED BY 2375 COWS, 934 HEIFERS, 112 HERD BULLS, AND 484 HORSES, IN 1921

Kind of feed	Total			Cows				Heifers		Bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Alfalfa, first cutting	4,700.0	$13.22	$62,128	128	$1,674	2,853	$37,836	591.5	$7,913	171.5	$2,250	956	$12,455
Alfalfa, second cutting	2,165.0	16.23	35,131	71.5	1,121	1,728.5	28,202	282.2	4,542	39.8	628	43	638
Alfalfa, third cutting	446.5	16.80	7,503	35	534	373.5	6,298	27	481	9	156	2	34
Alfalfa, fourth cutting	6.0	16.00	96	......	......	6	96	......	......	......	......	......	......
Mixed hay (clover)	188.0	13.61	2,558	......	......	123	1,678	11.8	162	7.2	107	46	611
Mixed hay (other)	417.0	12.95	5,401	......	......	74	999	41	497	13	175	289	3,730
Rowen	27.0	15.59	421	......	......	27	421	......	......	......	......	......	......
Timothy	347.5	15.23	5,294	......	......	83.5	1,349	25	403	3.5	54	235.5	3,488
Oat hay	58.0	14.02	813	......	......	38	512	2	16	......	......	18	285
Oat and pea hay	9.0	12.00	108	......	......	9	108	......	......	......	......	......	......
Total hay	8,364.0	$14.28	$119,453	234.5	$3,329	5,315.5	$77,499	980.5	$14,014	244.0	$3,370	1,589.5	$21,241
Oat straw	19.0	$6.37	$121	......	......	6	$ 42	......	......	......	......	13	$79
Wheat straw	3.0	6.00	18	......	......	3	18	......	......	......	......	......	......
Corn stover	140.0	3.76	527	3	$ 4	121	446	14	$ 63	2	$14	......	......
Corn fodder	179.0	3.89	697	6	24	150	508	23	165	......	......	......	......
Total straw stover, etc.	341.0	$4.00	$1,363	9	$28	280	$1,014	37	$228	2	$14	13	$79
Total home-grown	8,705.0	$13.88	$120,816	243.5	$3,357	5,595.5	$78,513	1,017.5	$14,242	246.0	$3,384	1,602.5	$21,320
Purchased:													
Alfalfa, first cutting	95.5	$11.85	$1,132	......	......	74	$895	13.5	$146	......	......	8	$ 91
Alfalfa, second cutting	16.0	17.00	272	......	......	14	236	......	......	......	......	2	36
Alfalfa, third cutting	3.0	10.00	30	......	......	3	30	......	......	......	......	......	......
Mixed hay	31.0	15.06	467	......	......	18.5	259	3	42	2.5	$35	7	131
Total purchased	145.5	$13.07	$1,901	......	......	109.5	$1,420	16.5	$188	2.5	$35	17	$258
Total dry forage	8,850.5	$13.87	$122,717	243.5	$3,357	5,705.0	$79,933	1,034.0	$14,430	248.5	$3,419	1,619.5	$21,578

TABLE 36. DRY FORAGE USED BY 2066 COWS, 862 HEIFERS, 99 HERD BULLS, AND 418 HORSES, IN 1922

Kind of feed	Total			Cows				Heifers		Bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Alfalfa, first cutting	4,576	$10.96	$50,141	36	$ 370	2,965	$32,610	606	$6,641	176	$1,961	793	$8,559
Alfalfa, second cutting	1,506	14.79	22,273	110	1,637	1,257.5	18,437	117	1,797	11.5	195	10	207
Alfalfa, third cutting	116	14.94	1,733	13	195	94	1,407	9	131	.....	..	.....	......
Mixed hay (clover)	228.5	10.83	2,474	......	......	129.5	1,414	44	480	10	94	45	486
Mixed hay (other)	454	10.70	4,860	......	......	159	1,742	43	465	14	152	238	2,501
Mixed hay, second cutting	4	12.00	48	......	......	......	......	......	......	......	......	4	48
Sweet clover	50	3.50	175	......	......	40	140	10	35	......	....	......	......
Rowen	5	12.00	60	......	......	......	......	5	60	......	......	......	......
Timothy	229	11.60	2,657	......	......	18	211	9	74	1	10	201	2,362
Oat hay	30	11.33	340	......	......	24	265	......	......	......	......	6	75
Pea hay	10	10.00	100	......	......	10	100	......	......	......	......	......	......
Rye hay	5	10.00	50	......	......	5	50	......	......	......	......	......	......
Alfalfa, 1921	13	6.38	83	......	......	13	83	......	......	......	......	......	......
Total hay	7,226.5	$11.76	$84,994	159	$2,202	4,715.0	$56,459	843	$9,683	212.5	$2,412	1,297	$14,238
Oat straw	16.5	$ 8.00	$132	......	......	16.5	$132	......	......	......	......	......	......
Corn stover	87	8.09	704	11	$ 42	76	662	......	......	......	......	......	......
Corn fodder	6	10.00	60	......	......	4	40	2	$20	......	......	......	......
Peavines, dry	25	6.80	170	25	170	......	......	......	......	......	......	......	......
Total straw, stover, etc.	134.5	$ 7.93	$1,066	36	$212	96.5	$834	2	$20	......	......	......	......
Total home-grown	7,361.0	$11.69	$86,060	195	$2,414	4,811.5	$57,293	845	$9,703	212.5	$2,412	1,297	$14,238
Purchased:													
Alfalfa, first cutting	49	$11.47	$562	......	......	46	$534	1	$10	......	....	2	$18
Alfalfa, second cutting	9	11.11	100	......	......	9	100	......	......	......	......	......	......
Mixed hay	45.5	9.58	436	......	......	40.5	406	......	......	2	$12	3	18
Timothy	8	6.88	55	......	......	8	55	......	......	......	......	......	......
Damaged alfalfa	3	4.00	12	......	......	3	12	......	......	......	......	......	......
Total purchased	114.5	$10.17	$1,165	......	......	106.5	$1,107	1	$10	2	$12	5	$36
Total dry forage	7,475.5	$11.67	$87,225	195	$2,414	4,918.0	$58,400	846	$9,713	214.5	$2,424	1,302	$14,274

TABLE 37. DIGESTIBLE CRUDE PROTEIN AND NET ENERGY USED BY COWS IN PASTURE AND WINTER PERIODS

	125 Grade B alfalfa farms, 2375 cows					108 Grade B alfalfa farms, 2066 cows				
	Concentrates	Silage (corn)	Other succulent feed	Dry forage	Total	Concentrates	Silage (corn)	Other succulent feed	Dry forage	Total
Pasture period:										
Protein:										
Total pounds	47,326	10,520	103,367	47,210	208,423	27,561	5,980	55,548	40,550	129,639
Per cent	22.7	5.0	49.6	22.7	100.0	21.3	4.6	42.8	31.3	100.0
Energy:										
Total therms	219,150	125,714	434,995	170,474	950,333	124,187	71,461	226,199	139,464	561,311
Per cent	23.1	13.2	45.8	17.9	100.0	22.1	12.7	40.3	24.9	100.0
Winter period:										
Protein:										
Total pounds	565,833	182,504	3,656	1,056,383	1,808,376	455,861	146,310	9,554	908,496	1,520,221
Per cent	31.3	10.1	0.2	58.4	100.0	30.0	9.6	0.6	59.8	100.0
Pounds per cow	238	77	1	445	761	221	71	4	440	736
Pounds per cow per day	1.14	0.37	0.01	2.14	3.66	1.08	0.35	0.02	2.14	3.59
Energy:										
Total therms	2,593,229	2,180,923	23,456	4,022,986	8,820,594	1,949,568	1,748,404	52,277	3,455,820	7,206,069
Per cent	29.4	24.7	0.3	45.6	100.0	27.0	24.3	0.7	48.0	100.0
Therms per cow	1,092	918	10	1,694	3,714	944	846	25	1,673	3,488
Therms per cow per day	5.3	4.4	0.1	8.1	17.9	4.6	4.1	0.1	8.2	17.0
Protein-energy ratio, 1:	4.6	12.0	6.4	3.8	4.9	4.3	11.9	5.5	3.8	4.7
		11.8*					11.6*			

*Protein-energy ratio, average for silage and other succulent feed.

higher there than in any of the other areas except Tully and Homer. The use of alfalfa, especially in the summer as a soiling crop, is not a method of keeping down the feed cost per cow in regions such as the one studied, where alfalfa has a high value for grinding for meal, or for shipping; it is a means of reducing the feed cost per unit of product chiefly because, since it is highly stimulating to milk production, enough increased product is obtained from a cow to lower the unit cost.

In 1921, 31.3 per cent of protein in the winter-period feed was derived from concentrates, 10.3 per cent from succulent feed, and 58.4 per cent from dry forage. In 1922, a slightly larger proportion was derived from dry forage. The protein content averaged 3.66 pounds per cow per day in winter in 1921, and 3.59 per cow per day in 1922.

In 1921, 29.4 per cent of the energy of the winter-period feed was derived from concentrates, 25.0 from succulent feed, and 45.6 from dry forage. In 1922, due to the feeding of less grain, a smaller percentage of the energy was derived from concentrates and a larger percentage from dry forage. The same amount came from succulent feed as in the preceding year.

The protein-energy ratio of grain was slightly lower in 1922 than in the preceding year, a fact which indicates the use of concentrates carrying slightly more protein than those used the year before. This results in a total ration narrower than that of the preceding year.

Much of the increased yield per cow in this area over that of all other areas previously reported is due to the high protein content of the rations, as the cows in this region received over 761 pounds of protein in 1921, and 736 pounds of protein in the winter rations as compared to the 478 pounds of protein fed in the Norwich area.[3] The winter-period yield was 2864 pounds of milk in the Norwich area, or 5.99 pounds per pound of protein. In this area in 1921 it was 3991 pounds, or 1127 pounds more per cow, and averaged 5.24 pounds per pound of protein. The winter-period yield is almost proportional to the protein intake in winter.

Since the expense for feed and labor represents over one-half of the total farm expenses, the business aspects of these two details of operating a farm are the most important farm-management problems on the farms as they are now organized.

Economies in feeding animals may result from borrowing money from a bank to purchase feed in quantities in months of low prices. They may result also from the use of the kinds of concentrates with the kinds of roughage that give the greatest production for the cost. Securing the greatest production for the expenditure for feed is just as much of a farm-management problem as saving money in the purchase of feed. The farm-management question is how to increase the net income. Saving on the purchase of feed is one way of doing it. Securing a profitable production by an effective system of feeding is another.

The results given in table 38 furnish a comparison of the returns per hour spent on cows in six regions studied. The returns per hour on cows in the alfalfa region were more than in the Norwich area, where condensery milk was produced with ordinary mixed hay roughage; but

[3] Economic studies of dairy farming in New York. I. Condensery milk without cash crops. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bul. 421, 1923, p. 36.

TABLE 38. RESULTS OF COST STUDIES, 16,070 COWS ON 763 FARMS

County	Broome	Herkimer	Chenango	Chenango	Madison	Madison	Onondaga and Cortland
Market grade of milk	B	Condensery	Condensery	A	B, with alfalfa roughage	B, with alfalfa roughage	A
Number of farms	149	163	83	84	125	108	51
Year	1914	1918	1921	1921	1921	1922	1921
Number of cows	2,058	4,136	2,073	2,088	2,375	2,066	1,274
Concentrates	$30	$62	$37	$37	$37	$41	$37
Silage	5	7	6	6	5	5	5
Other succulent feed	3	7	6	5	6	5	5
Hay	10	20	17	16	14	12	15
Other dry forage	5	9	6	8	4	8	5
Labor per hour	0.14	0.35	0.27	0.26	0.25	0.28	0.31
Cost of milk	1.69	3.60	2.73	2.59	2.50	2.54	2.79
Price of milk	1.64	2.98	2.04	2.42	2.18	2.19	2.61
Difference	0.05	0.62	0.69	0.17	0.32	0.35	0.18
Returns per hour	0.11	0.18	0.03	0.20	0.14	0.16	0.24
Pounds of milk produced per cow	5,532	5,174	5,272	5,724	6,592	6,330	6,337
Butterfat test	4.0	3.5	3.5	3.6	3.4	3.4	3.5
Pounds of fat per cow	222	181	182	205	223	214	221

they were less than the returns in the Oxford area, where Grade A milk was produced with ordinary mixed hay roughage; and still less than the returns in the Tully and Homer area, where Grade A milk was produced with one-third alfalfa, and two-thirds mixed hay, for roughage. This difference in returns is largely determined by the price for the milk; but at the same time, it emphasizes that, from the standpoint of net returns, the price received by the producers is as important as the kinds of roughage used, or the system under which the product is produced. In other words, the farmers with price premiums for their milk were doing slightly better than those using the choicest kinds of roughage but having only the ordinary market for their milk. It is probable that over a period of years the average producer who receives premiums for low-count milk produced with ordinary mixed hay roughage is better situated financially than the producer receiving the ordinary market price for milk and using alfalfa hay for roughage.

Quantities of feed used

The quantities of feed used per cow and per unit of product for the year for each of the two years covered by the study are shown in table 39. In 1921 the fall-fresh herds used 345 pounds of grain per cow more than did the spring-fresh herds. In the winter dairies 511 pounds more of other succulent feed, chiefly green alfalfa, was fed, but about the same amount of silage and of hay was used. In 1922 the fall-fresh herds used only 157 pounds more of concentrates per cow than did the spring dairies, but they used 1031 pounds less of other succulent feed and about half a ton less of dry forage per cow. The winter of 1922 was accompanied by a less intensive practice in winter dairies.

The quantity of feed used per cow per day and per unit of product during the winter period, and per unit of product during the pasture period, is

TABLE 39. AMOUNTS OF FEED USED PER COW, AND PER UNIT OF PRODUCT, FOR THE YEAR, IN POUNDS

	Per cent of cows freshening from September to December inclusive							
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent		All herds	
	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced
	125 farms in 1921							
Concentrates	1,264	20.0	1,674	26.0	1,609	23.3	1,561	23.7
Silage	7,830	123.6	8,112	125.9	8,322	120.3	8,127	123.3
Other succulent feed	1,918	30.3	1,625	25.2	1,407	20.3	1,600	24.4
Dry forage	5,070	80.0	4,818	74.8	5,191	75.1	5,009	76.0
Days of pasture	159	2.5	158	2.5	155	2.2	157	2.4
Acres of pasture	3.0	....	2.8	....	3.1	....	2.9	....
	108 farms in 1922							
Concentrates	1,271	21.3	1,264	20.1	1,428	22.1	1,346	21.3
Silage	7,771	130.4	5,983	95.2	8,370	120.7	7,371	110.5
Other succulent feed	2,008	33.7	1,126	17.9	977	15.2	1,155	18.2
Dry forage	5,783	97.1	4,433	78.5	4,767	73.0	4,050	78.2
Days of pasture	164	2.8	161	2.6	158	2.4	160	2.5
Acres of pasture	3.3	.....	3.4	....	3.0	......	3.2	.....

shown in table 40. For all herds slightly more silage and dry forage and less concentrates were used per 100 pounds of milk produced in the winter of 1922 than in 1921.

The average pounds of feed used per cow for the year were: for 1921, concentrates, 1561; succulent feed, 9736; and dry forage, 5009; for 1922, concentrates, 1346; succulent feed, 8526; and dry forage, 4050. Pasture was better in 1922, and less grain and succulent feed was used both supplementary to pasture and during the winter of 1922. Lower yields of corn caused a greater shortage of roughage in 1922, and the feeding was not so liberal as it had been in the preceding winter.

The average pounds of feed per horse used during the year were: for 1921, concentrates, 2489; alfalfa, 4178; and other dry forage, 2515; for 1922, concentrates, 1978; alfalfa, 3852; and other dry forage, 2378 The feed and pasture cost was $88.07 per horse in 1921 and $68 per horse in 1922.

Pasture

For the season of 1921, the average length of the pasture season was 157 days. The average date of turning out in the spring was the morning of May 16, and of stabling in the fall the night of October 19.

For the season of 1922, the average length of the pasture season was 160 days. The average date of turning out in the spring was the morning of May 16, and of stabling in the fall the night of October 22.

The average charge for the use of pasture was $8.53 per cow in 1921 and $6.99 per cow in 1922, in addition to the charge for using meadows, cabbage fields, and the like, as pasture (table 41). The pastures of this area are of two general descriptions: gravelly soils on which the grass does not hold well, and heavier soils of silty texture of varying degrees of depth over lime rock. The latter type furnishes more pasture of better kinds of plants.

TABLE 40. AMOUNTS OF FEED USED PER COW PER DAY, AND PER UNIT OF PRODUCT, IN PASTURE AND WINTER PERIODS, IN POUNDS

	Per cent of cows freshening from September to December inclusive									All herds		
	Less than 25 per cent			From 25 to 50 per cent			More than 50 per cent					
	Total	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Total	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Total	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per 100 pounds of milk produced in pasture period
1921:												
Concentrates (pounds)	586,000	5.5	33.4	1,530,700	7.5	41.1	1,302,600	7.2	32.6	6.9	36.1	4.7
Silage (pounds)	3,936,000	37.0	224.4	7,565,400	36.9	202.9	6,749,000	37.1	168.9	36.9	192.5	17.0
Other succulent feed (pounds)	15,600	0.1	0.9	111,800	0.5	3.0	116,000	0.6	2.9	0.5	2.6	57.9
Dry forage (pounds)	2,474,000	23.2	141.1	4,581,000	22.3	122.9	4,355,000	23.9	109.0	23.1	120.4	7.9
Days of pasture	...	...	...	...	...	...	...	...	...	...	...	6.0
Acres of pasture	...	...	...	...	...	...	...	...	...	...	...	0.113
1922:												
Concentrates (pounds)	291,500	6.0	46.3	943,700	5.8	33.6	1,382,300	6.5	34.2	6.2	35.0	2.9
Silage (pounds)	1,741,000	36.1	276.7	4,712,000	28.7	167.6	8,178,000	38.7	202.2	34.5	195.5	10.7
Other succulent feed (pounds)	136,000	2.8	21.6	271,000	1.7	9.6	80,000	0.4	2.0	1.1	6.5	34.0
Dry forage (pounds)	1,358,000	28.2	215.8	3,754,000	22.9	133.5	4,724,000	22.3	116.8	23.2	131.4	7.0
Days of pasture	...	...	...	...	...	...	...	...	...	...	...	5.9
Acres of pasture	...	...	...	...	...	...	...	...	...	...	...	0.119

TABLE 41. PASTURE CHARGES IN 1921 AND 1922

	125 farms in 1921			108 farms in 1922		
	Number of animal units pastured	Charge for pasture		Number of animal units pastured	Charge for pasture	
		Total	Per animal unit		Total	Per animal unit
Cows	2,333.5	$19,903	$ 8.53	2,132	$14,900	$ 6 99
Heifers	394	3,878	9.84	300.5	2,815	9.37
Bulls	70	485	6 93	39.8	283	7.11
Horses	136 5	818	5.99	60	367	6.12
Colts	6	68	11.33	2	20	10.00
Sheep	6	70	11.67	....	......	.....
Meadows pastured after hay was removed	737	$1,835	$2.49	1,021	$2,183	$2.14
Cabbage bait	....	......	......	21	60	2.86
Corn bait	.....	...	......	14	100	7.14

Bedding

The kinds of bedding used were mostly home-grown straws, chiefly oat (table 42). Some sawdust, straw, and shavings were purchased. The charge for bedding amounted to $1.68 per cow, or 3 cents per 100 pounds of milk, in 1921, and $1.69 per cow, or 3 cents per 100 pounds of milk, in 1922.

Labor

The charges for the direct human labor on cows averaged $37.58 per cow, or 60 cents per 100 pounds of milk sold, in 1921 and $43.48 per cow, or 73 cents per 100 pounds of milk sold, in 1922.

The average rates per hour for labor were: in 1921, human, 25 cents, and horse, 16 cents; in 1922, human, 28 cents, and horse, 18 cents. The variations in rates per hour asked by operators and the estimated rates paid for hired labor each year are given in table 43.

The time spent on cows averaged, in 1921, 172 hours per cow, and in 1922, 179 hours per cow. In 1921 this amounted to 2.6 hours, and in 1922 to 2.8 hours, per 100 pounds of milk produced (table 44).

As in other regions, more than half of the time spent on cows was in the milking and the hauling of the milk, the total of this labor averaging 97.5 hours per cow in 1921, and 96.1 hours per cow in 1922. The average hours in milking, per cow, were 73 in 1921 and 75 in 1922. More time is spent in milking in this region than in any of the others studied, because more milk is obtained per cow and the herds are smaller. The large amount of labor necessitated by the frequent cutting of alfalfa to be fed green would make the amount of indirect labor for cows with this system greater than with the ordinary system of dairying.

The efficient operation of a dairy farm requires a herd large enough to utilize fully the labor of two men. The herds in this area are not large enough to efficiently employ two men by the year. One of the chief adjustments necessary in obtaining a more efficient dairy farm in this region is a change in the size of the business.

TABLE 42. BEDDING USED ON FARMS IN 1921 AND 1922

	125 farms in 1921								108 farms in 1922					
	Cows		Heifers		Herd bulls		Horses		Cows		Heifers		Horses	
	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:														
Oat straw	357.2	$2,415	72.6	$475	2.5	$18	178	$1,194	376	$2,381	56	$358	120	$729
Old oat straw	...	...	...	...	...	...	1	10	5	51	...	...	1	3
Oat and barley straw	44	352	5	36	...	...	24	205	48	347	8	70	18	121
Oat, barley, and wheat straw	7 4	59	3	24	0.6	5	3	24	...	...	...	...	...	...
Oat, barley, and pea straw	11	86	1	10	...	...	12	96	...	...	...	...	...	...
Oat and wheat straw	8	45	3.5	19	0.5	4	8	53	...	...	...	...	...	...
Oat, pea, barley, and wheat straw	3	24	...	...	...	...	1	8	...	...	...	...	...	...
Oat, pea, barley, spring wheat, and buckwheat straw	...	...	...	...	...	...	...	...	5	50	1	10	2	20
Barley straw	31.5	208	6.2	46	...	...	10.5	68	8	45	3	17	4	24
Rye straw	...	...	...	...	...	...	...	...	...	...	...	...	2	18
Wheat straw	48.3	342	8	52	0.2	1	57.5	408	51	312	17	109	41	268
Buckwheat straw	...	...	...	...	...	...	...	...	12	70	1	10	...	...
Speltz straw	...	...	...	...	...	...	...	...	1	9	...	...	...	...
Hay	2	10	0.5	1	...	...	0.5	1	...	...	...	...	...	...
Buckwheat for bedding	5	50	3.3	26	0.2	1	4	35	...	...	...	...	...	...
Oat hay for bedding	...	...	...	...	...	...	...	...	3	9	...	...	...	...
Oat and pea straw	...	...	...	...	...	...	...	...	...	...	1	5	...	...
Total	...	$3,591	...	$689	...	$29	...	$2,102	...	$3,274	...	$579	...	$1,183
Purchased:														
Straw	32.2	$149	2	$15	0.3	$1	4.5	$29	20.5	$104	...	...	3	$20
Shavings	13.8	197	1.1	17	...	...	2.6	16	0.2	2	...	...	...	...
Sawdust	25	68	0.5	2	...	...	4	12	23.25	115	...	...	...	...
Alfalfa waste	...	...	...	...	...	...	...	...	2	10	...	...	...	...
Total	...	$405	...	$34	...	$1	...	$57	...	$231	...	...	...	$20
Total bedding	...	$3,996	...	$723	...	$30	...	$2,159	...	$3,505	...	$579	...	$1,203

TABLE 43. VARIATION IN RATES PER HOUR FOR OPERATORS AND HIRED MEN

Rate per hour (cents)	125 farms in 1921				108 farms in 1922			
	Operators		Hired men		Operators		Hired men	
	Number of farms	Per cent	Number of farms	Per cent	Number of farms	Per cent	Number of farms	Per cent
4	....	....	1	1.4	....	....	....	....
7	....	....	1	1.4	....	....	....	....
8	....	....	....	....	....	....	2	3.0
10	....	....	1	1.4	....	....	1	1.5
11	....	....	1	1.4	....	....	....	....
12	....	....	3	4.1	....	....	....	....
13	2	1.6	2	2.7	....	....	2	3.0
14	1	0.8	2	2.7	....	....	....	....
15	....	....	4	5.5	....	....	5	7.6
16	4	3.2	9	12.4	....	....	3	4.6
17	5	4.1	4	5.5	1	0.9	6	9.1
18	....	....	6	8.2	....	....	9	13.6
19	....	....	2	2.7	....	....	3	4.6
20	3	2.4	6	8.2	3	2.8	10	15.2
21	....	....	2	2.7	1	0.9	....	....
22	1	0.8	5	6.8	....	....	3	4.6
23	1	0.8	2	2.7	6	5.6	5	7.6
24	2	1.6	3	4.1	1	0.9	2	3.0
25	24	19.4	9	12.4	13	12.0	8	12.1
26	3	2.4	2	2.7	3	2.8	....	....
27	2	1.6	1	1.4	1	0.9	1	1.5
28	6	4.9	2	2.7	6	5.6	2	3.0
29	1	0.8	....	....	1	0.9	1	1.5
30	21	16.9	4	5.5	10	9.3	1	1.5
31	....	....	1	1.4	....	....	1	1.5
32	3	2.4	....	....	3	2.8	1	1.5
33	11	8.9	....	....	22	20.4	....	....
34	....	....	....	....	1	0.9	....	....
35	17	13.7	....	....	4	3.7	....	....
36	....	....	....	....	2	1.9	....	....
38	....	....	....	....	1	0.9	....	....
40	7	5.7	....	....	8	7.4	....	....
41	2	1.6	....	....	1	0.9	....	....
42	3	2.4	....	....	11	10.2	....	....
43	....	....	....	....	3	2.8	....	....
45	1	0.8	....	....	....	....	....	....
50	3	2.4	....	....	5	4.6	....	....
53	....	....	....	....	1	0.9	....	....
75	1	0.8	....	....	....	....	....	....
Total	124*	100.0	73	100.0	108	100.0	66	100.0

* On one farm the operator did no work on cows.

TABLE 44. LABOR REQUIRED IN PASTURE AND WINTER PERIODS

	Hours in pasture period				Hours in winter period				Total hours			
	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value
125 farms in 1921:												
Human labor for cows:												
Hauling milk	22,661	9.6	0 4	$ 5,740	36,444	15 3	0.4	$ 9,246	59,105	24.9	0.4	$14,986
Milking	72,649	30.6	1.2	18,487	99,804	42.0	1 0	25,425	172,453	72.6	1.1	43,912
Other human labor	25,246	10.6	0.4	6,438	152,842	64.4	1.6	38,902	178,088	75.0	1.1	45,340
Total	120,556	50.8	2.0	$30,665	289,090	121.7	3.0	$73,573	409,646	172.5	2.6	$104,238
Total except hauling milk	97,895	41.2	1 6	$24,925	252,646	106 4	2.6	$64,327	350,541	147.6	2.2	$ 89,252
Horse labor for cows:												
Hauling milk	31,909	13 4	0.5	$5,020	65,076	27.4	0.7	$10,237	96,985	40.8	0.6	$15,257
Other horse labor	1,358	0.6	0.0	222	23,684	10.0	0.2	3,888	25,042	10.6	0.2	4,110
Total	33,267	14.0	0.5	$5,242	88,760	37.4	0.9	$14,125	122,027	51.4	0.8	$19,367
Human labor for heifers	1,120	...	...	$293	21,114	...	...	$5,569	22,234	...	...	$5,862
Horse labor for heifers	...	...	...	...	3,632	...	...	$577	3,632	...	...	$577
108 farms in 1922:												
Human labor for cows:												
Hauling milk	17,440	8.4	0.3	$ 4,870	26,508	12.8	0.4	$ 7,398	43,948	21.2	0.3	$12,268
Milking	66,737	32.3	1.2	18,350	88,054	42.6	1.2	24,226	154,791	74.9	1.2	42,576
Other human labor	18,935	9.2	0.3	5,197	152,602	73.9	2.0	42,049	171,537	83.1	1.3	47,246
Total	103,112	49.9	1.8	$28,417	267,164	129.3	3.6	$73,673	370,276	179.2	2.8	$102,090
Total except hauling milk	85,672	41.5	1.5	$23,547	240,656	116.5	3.2	$66,275	326,328	158.0	2.5	$89,822
Horse labor for cows:												
Hauling milk	26,418	12.8	0.5	$4,677	48,400	23.4	0.7	$8,572	74,818	36.2	0.6	$13,249
Other horse labor	2,713	1.3	0.0	491	39,911	19.3	0 5	7,174	42,624	20.6	0.3	7,665
Total	29,131	14.1	0.5	$5,168	88,311	42.7	1.2	$15,746	117,442	56.8	0 9	$29,914
Human labor for heifers	134	...	...	$39	28,095	...	...	$7,772	28,229	...	...	$7,811
Horse labor for heifers	...	...	...	...	4,841	...	...	$859	4,841	...	...	$859

Hauling milk

The average distance to the milk stations from the farms included in 1921 was 2.4 miles, and from the farms included in 1922, 3.0 miles. The charges for hauling the milk were: in 1921, $15.19 per cow, and 24 cents per 100 pounds of milk; in 1922, $13.58 per cow, and 23 cents per 100 pounds of milk. The data are given in table 45.

Most of the farmers haul their own milk or change with neighbors. The custom is to hire less of it hauled. More trucks and automobiles are being used each year.

TABLE 45. CHARGES FOR HAULING AND DELIVERY TO THE MILK STATION

	148,252 hundredweight of milk from 125 farms in 1921			123,610 hundredweight of milk from 108 farms in 1922		
	Pasture period	Winter period	Total	Pasture period	Winter period	Total
Human labor:						
Number of farms...	124	124	....	105	105	....
Hours....	22,661	36,444	59,105	17,440	26,508	43,948
Value.....	$5,740	$9,246	$14,986	$4,870	$7,398	$12,268
Horse labor:						
Number of farms...	99	118	... ...	77	99	....
Hours.....	31,909	65,076	96,985	26,418	48,400	74,818
Value........... ..	$5,020	$10,237	$15,257	$4,677	$8,572	$13,249
Value of total human and horse labor....	$10,760	$19,483	$30,243	$9,547	$15,970	$25,517
Hauling hired:						
Number of farms...	. ....	. .....	18	....	....	5
Cash paid...... ...	......	. .....	$1,907	....	....	$420
Use of automobiles and trucks:						
Number of farms...	....	....	28	....	....	29
Value.......... .	....	....	$4,033	....	....	$2,109
Total charges for hauling milk..........	....	....	$36,183	....	....	$28,046
Amount received for hauling milk.	... ...	......	$120	....	....	....
Total net cost of hauling milk...........	. .....	....	$36,063	....	....	$28,046
Net cost per 100 pounds of hauling milk..............	....	....	$0.24	....	....	$0.23

Use of buildings

The average charge for the use of buildings was $7.42 per cow, or 12 cents per 100 pounds of milk, in 1921, and $7.13 per cow, or 12 cents per 100 pounds of milk, in 1922. The construction of the charge for buildings is shown in table 46.

Of the 125 farmers, 80 had barns so arranged that the cows faced outward, and 40 had barns so arranged that the cows faced inward. Of the total number, 57 drove thru for the manure, and 10 had litter carriers.

TABLE 46. CHARGES FOR USE OF BUILDINGS ON FARMS

	125 farms in 1921	108 farms in 1922
Value of barns and other buildings used for dairy cattle	$236,225	$212,850
Interest at 5 per cent	$11,807	$10,645
Taxes	3,595	3,392
Insurance	1,486	1,147
Repairs	4,796	3,198
Total	$21,684	$18,382
Charged to:		
Cows	$17,616	$14,727
Heifers	3,260	2,987
Herd bulls	808	668
Total	$21,684	$18,382

Forty farmers had swing stanchions, 80 had straight stanchions, 3 had both straight and swing stanchions, and 2 tied with chains. Of the floors, 107 were concrete and 10 were wood. Twenty-eight of the farmers had water buckets in the barns, 66 watered cows in yard tubs, 9 watered cows in tubs in the barn, 1 watered in the mangers, and the remainder used creeks or springs.

Use of equipment

The charges for use of equipment were: for 1921, $1.53 per cow, or 2 cents per 100 pounds of milk; and for 1922, 81 cents per cow, or 1 cent per 100 pounds of milk.

All charges for use of special cattle equipment amounted to 19.0 per cent of the value of the equipment in 1921, and to 11.3 per cent in 1922.

Interest

The interest at 6 per cent on the average value of cows amounted in 1921 to $6.10 per cow, or 10 cents per 100 pounds of milk; and in 1922 to $6.08 per cow, or 10 cents per 100 pounds of milk. No interest was charged on the average value of feed and supplies kept on hand for cows.

Depreciation on cows

The average values given the cows were: for 1921, grades, $88.49; purebreds, $159.68; for both, $101.60; and for 1922, grades, $88.97; purebreds, $158.56; for both, $101.30. The depreciation was $2.94 per head, or 5 cents per 100 pounds of milk, in 1921, 2.9 per cent of the average value of cows. In 1922 the depreciation was $3.46 per head, or 6 cents per 100 pounds of milk, 3.4 per cent of the average value of cows. Estimates as to the change in market value of grade cows during the year averaged $21.88 decrease per head for the season of 1921, and $1.61 increase per head for 1922. This was not included as a charge or a credit.

TABLE 47. COST OF BULL SERVICE

	125 farms in 1921				108 farms in 1922			
	Total		Per cattle unit		Total		Per cattle unit	
	Amount	Value	Amount	Value	Amount	Value	Amount	Value
Costs:								
Concentrates	766 cwt.	$1,397	730 lbs.	$13.31	578 cwt.	$1,242	633 lbs.	$13.60
Succulent feed	273.3 tons	1,427	5,206 lbs.	13.59	160.5 tons	856	3,516 lbs.	9.38
Dry forage	248.5 tons	3,419	4,733 lbs.	32.56	214.5 tons	2,424	4,699 lbs.	26.55
Whole milk	17,472 lbs.	371	166 lbs.	3.53	15,824 lbs.	354	173 lbs.	3.88
Pasture	...	485	...	4.62	...	283	...	3.10
Bedding	4.3 tons	30	82 lbs.	0.29	...	...	...	...
Interest	...	585	...	5.57	...	456	...	4.99
Depreciation (net)	...	...	...	...	...	944	...	10.34
Use of buildings	...	808	...	7.70	...	668	...	7.32
All other costs	...	1,590	...	15.14	...	2,123	...	23.25
Total	...	$10,112	...	$96.31	...	$9,350	...	$102.41
Returns:								
Appreciation	...	$857	...	$8.16	...	...	...	...
Manure	859 tons	1,547	8.2 tons	14.74	682 tons	$1,163	7.5 tons	$12.74
Total	...	$2,404	...	$22.90	...	$1,163	...	$12.74
Cost of keeping own herd bulls	...	$7,708	...	$73.41	...	$8,187	...	$89.67
Service hired	...	$353	...	...	...	...	...	...
Net cost of bull service	...	$8,061	...	...	...	$8,187	...	...
Net cost per cow	...	$3.39	...	...	...	$3.96	...	...
Number of herd bulls	...	112.4	...	...	...	99.3	...	...
Cattle units of herd bulls	...	105.0	...	...	...	91.3	...	...

The number of cows that were sold, that were eaten on farms, and that died, was 18.6 for each 100 cows in 1921, and 23.8 for each 100 cows in 1922. The replacement was higher in 1922 than in 1921, due apparently to the sale of younger cows.

The importance of skill in profitable dairy management is sometimes underestimated. The facts are that much attention is required to prevent successfully, hold in check, or cure, the many diseases and ailments to which cattle are subject. Heavy depreciation is constantly suffered because of neglect in these precautions. When to this is added the skill required in selecting and breeding animals that will be heavy and efficient producers, in providing proper rations during the resting period and highly stimulating rations during the milking period, the difficulties in rearing young cattle, and the necessity of accepting prices based on widespread competition in production, it is more evident that dairying is one of the most complex types of farming.

Bull service

The average cost of keeping 112 herd bulls in 1921 was $73.41 per cattle unit, or $3.39 per cow. In 1922 the cost was $89.67 per cattle unit of bulls for 99 bulls, or $3.96 per cow.

The quantities of feed and the remaining charges for both years are summarized in table 47.

Miscellaneous charges

The remaining expenses for cows are given in table 48. The most important of these are gasoline, veterinary fees, salt, insurance, and ice.

TABLE 48. MISCELLANEOUS EXPENSES ON COWS

Item	Charge	
	125 farms in 1921	108 farms in 1922
Advertising	$ 10	$ 110
Breeding fees	10	.....
Salt	1,249	788
Grinding feed	261	103
Freight and express	....	50
Hay, silage, stalks, straw	....	10
Electricity, carbide, etc	119	55
Insurance	936	1,125
Registration fees, transfers	....	79
Coal, oil, gasoline	2,173	831
Farm upkeep and operation of automobile and truck	530	250
Ice, and sawdust for ice	719	302
Milk bottles, cow testers, acids, etc	179	343
Spray materials	473	243
Telephone	246	349
Stamps and stationery	13	25
Veterinary fees and medicines	1,942	1,746
Any other farm expenses	278	92
Total	$9,138	$6,501
Total per cow	$3.85	$3.15
Total per 100 pounds of milk sold wholesale	$0.06	$0.05

RETURNS

Milk and milk products

The amounts of and the returns from milk sold have been given in tables 23 and 24 (page 28 and 29).

The milk used on the farms and the milk sold retail appear in table 49.

In 1921 the average amount of milk used at home for all purposes was 6596 pounds per farm, or 5.3 per cent of the total production. This was used as follows: operators' families, 2519 pounds; heifers, 3175 pounds; veals, 506 pounds; all other uses, 396 pounds. The average production per cow for 1921 was 6592 pounds of milk, containing 223 pounds of fat.

In 1922 the average amount of milk kept at home for all purposes was 6600 pounds per farm, or 5.5 per cent of the total production, used as follows: operators' families, 2687 pounds; heifers, 3270 pounds; veals, 291 pounds; all other uses, 352 pounds. The average production per cow for 1922 was 6330 pounds of milk, or 262 pounds less than in 1921. The fat production was 214 pounds per cow.

TABLE 49. RETURNS FROM MILK PRODUCTS SOLD AND MILK AND ITS PRODUCTS USED ON THE FARM

	125 farms in 1921			108 farms in 1922		
	Number of farms	Number of pounds of product	Total value	Number of farms	Number of pounds of product	Total value
Milk sold retail	2	6,279	$219	1	3,130	$140
Milk used:						
Operators' families	124	313,131	$6,440	108	290,178	$5,981
Landlords' families	2	3,085	58	1	785	15
Parents in town	......	....	......	1	1,570	31
Hired men's families	13	20,160	414	11	14,027	276
Total milk used	125	336,376	$6,912	108	306,560	$6,303
Milk products used:						
Skimmilk:						
Family	1	1,400	$ 4	......	....	......
Hogs	1	3,500	9	......	....	......
Butter, family use	4	330	132	......	....	......
Total milk and its products used, except that fed to cattle	125	341,606	$7,057	108	306,560	$6,303
Milk fed:						
Heifers	102	392,848	$9,395	93	353,168	$8,449
Veals	27	63,212	1,493	15	31,443	732
Bull calves to be kept for herd bulls	16	17,472	371	12	15,824	354
Bull calves to be sold	4	5,323	90	1	2,400	54
Total milk fed to cattle	110	478,855	$11,349	95	402,835	$9,589
Other animals	......	....	......	3	3,434	86
Total milk fed	110	478,855	$11,349	95	406,269	$9,675
Milk products fed:						
Skimmilk:						
Heifers	2	4,000	$10	......	....	......
Total milk and its products fed to cattle	110	482,855	$11,359	95	402,835	$9,589
Total milk and its products fed	110	482,855	$11,359	95	406,269	$9,675
Equivalent, in pounds of milk, of milk and its products used	125	824,461	......	108	712,829	......
Pounds of fat in milk retailed, milk products sold, and milk and its products used	......	27,799	......	......	24,261	......

TABLE 50. NUMBER OF CALVES BORN DURING YEAR, AND THEIR VALUE AT BIRTH

	125 farms in 1921					108 farms in 1922				
	Number of farms	Number	Per cent	Value	Value of each at birth	Number of farms	Number	Per cent	Value	Value of each at birth
Heifers to be raised or sold	100	......	......	......	......	92	......	......	......	......
Purebred	34	138	6.1	$2,734	$19.81	31	119	6.3	$2,421	$20.34
Grade	82	310	13.8	1,062	3.43	73	256	13.5	882	3.45
Bulls to be kept:	14					20				
Purebred	5	5	0.2	63	12.60	9	10	0.5	203	20 30
Grade	9	9	0.4	35	3.89	11	13	0.7	53	4.08
Bulls to be sold:	10					3				
Purebred	7	10	0.5	94	9.40	2	3	0.2	108	36 00
Grade	3	3	0.1	12	4.00	1	2	0.1	10	5.00
Calves vealed or to be vealed	123	1,720	76.4	4,040	2.35	107	1,431	75.4	3,514	2.46
Calves deaconed	17	55	2.5	......	......	15	63	3.3	......	......
Deacon hides	6	(24)	......	15	0.62	10	(29)	......	44	1.52
Total calves born alive*	124	2,250	100.0	$8,055	$3.58	108	1,897	100.0	$7,235	$3.81
Live calves per 100 cows	......	95	......	......	......	......	92	......	......	......
Calves born dead	39	90	......	......	......	44	97	......	......	......
Dead calf hides	3	5	......	7	......	4	10	......	11	......
Total credited to cows	......	......	......	$8,062	......	......	......	......	$7,246	......
Cows that aborted	2	2	......	......	......	1	25	......	......	......
Cows that will not breed	27	44	......	......	......	19	29	......	......	......
Cows with unsound quarters	74	144	......	......	......	56	108	......	......	......

* The total number of calves exceeded the number of cows by 5 in 1921 and by 4 in 1922, because of twins.

The total milk produced for 1921 was 15,655,966 pounds, of which 9,478,444 pounds was produced during the winter period. The total milk produced for 1922 was 13,077,014 pounds, of which 7,485,134 pounds was produced during the winter.

The average yields of cows in 1921 during the stabling period were 3991 pounds, or 19.2 pounds per day, and during the pasture period 2601 pounds, or 16.6 pounds per day. During 1922 the stabling period yield was 3623 pounds per cow, or 17.7 pounds per cow per day, and the pasture-period yield was 2707 pounds, or 16.9 pounds per cow per day.

Calves born during the year

A total of 2340 calves were born during the season of 1921, of which 90, or 3.8 per cent, were born dead, and a total of 1994 were born during the season of 1922, of which 4.9 per cent were born dead (table 50). Of the cows on hand at the end of the season of 1921, 6.0 per cent had unsound quarters, and 1.8 per cent would not breed. Of those on hand at the end of the season of 1922, 5.3 per cent had unsound quarters, and 1.4 per cent would not breed. The average weight of the cows was 979 pounds for 1921, and 977 pounds for 1922. The average number of weeks during which cows were dry was 7.1 for 1921 and 7.5 for 1922.

The value at birth of grade heifers was $3.44 and of purebreds $20. Of the total calves born alive, 79 per cent were vealed and deaconed. More calves are raised in this region than in the Norwich, Oxford, and Tully and Homer regions, previously reported in bulletins 421 and 433 of this station.

Manure

The average value of manure in 1921 was $1.80 per ton at the barnyard, and in 1922, $1.71 per ton at the barnyard, a decrease of 5 per cent in value. Manure was credited at this value. The amount recovered from cows was 8.1 tons per cow in 1921, and 7.5 tons per cow in 1922. The data are given in table 51:

TABLE 51. MANURE RECOVERED FROM CATTLE AND HORSES

	All stock	Cows	Heifers	Herd bulls	Bull calves to be sold	Steers	Horses
125 farms in 1921:							
Manure recovered (tons).....	27,940	19,347	3,715	859	39	......	3,980
Value at $1.80 per ton at the barnyard................	$50,291	$34,823	$6,679	$1,547	$72	......	$7,170
108 farms in 1922:							
Manure recovered (tons).....	22,917	15,516	3,262	682	15	16	3,426
Value at $1.71 per ton at the barnyard........	$39,184	$26,532	$5,579	$1,163	$25	$27	$5,858

Miscellaneous returns

The miscellaneous items credited to cows in 1921 amounted to $3.85 per cow, or 6 cents per 100 pounds of milk, and in 1922 to $3.15 per cow, or 5 cents per 100 pounds of milk.

SUMMARY OF COSTS AND RETURNS

The costs and the returns for cows, per cow and per 100 pounds of milk, for two years are given in table 52. The net cow cost of producing milk in 1921 was $2.50 per 100 pounds, and in 1922, $2.54 per 100 pounds.

In 1921, with concentrates at $37.33, silage at $5.19, and dry forage at $13.87, per ton, and labor at 25 cents per hour, the average loss was $19.87 per cow, in addition to an average decrease in the market value of cows of $21.88 per head, which has not been included as a charge. The loss per 100 pounds of milk sold was 32 cents. But after all charges except those for labor were met, the returns were 13.9 cents per hour for all time spent on the enterprise.

TABLE 52. SUMMARY OF COSTS AND RETURNS

	125 farms in 1921		108 farms in 1922	
	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale
Costs:				
Concentrates	$30.26	$0.48	$28.77	$0.48
Succulent feed	25.97	0 42	22.72	0.38
Dry forage	35.07	0.56	29.44	0.49
Pasture	9 15	0.15	8.34	0.14
Bedding	1.68	0.03	1.69	0.03
Human labor	37.58	0 60	43.48	0.73
Horse labor	1.73	0.03	3.71	0.06
Hauling milk	15.19	0 24	13 58	0.23
Use of buildings	7.42	0 12	7.13	0.12
Use of equipment	1.53	0 02	0.81	0.01
Interest on cows	6.10	0.10	6.08	0.10
Depreciation on cows	2.94	0.05	3 46	0.06
Bull service	3 39	0.05	3.96	0.07
Miscellaneous	3.85	0 06	3.15	0.05
Total costs	$181.86	$2.91	$176 32	$2.95
Returns:				
Milk sold wholesale:				
Cash	$129.23	$2 07	$126 86	$2.12
Certificates of indebtedness	6.78	0 11	4.57	0 07
Milk products sold and milk retailed	0 09	....	0.07	....
Milk and milk products used except that fed to cattle	2.97	0.05	3 09	0.05
Milk and milk products fed to cattle	4.79	0.07	4.64	0.08
Calves and calf hides	3.39	0.05	3.51	0 06
Manure	14.66	0.24	12.84	0.22
Miscellaneous	0.08	....	0.09	....
Total returns	$161.99	$2.59	$155.67	$2.60
Loss	$19.87	$0 32	$20 65	$0.35
Cow cost of producing milk	$155 88	$2.50	$152.08	$2.54
Herd cost of producing milk	....	$2.59	....	$2.65
Cow cost per pound of butterfat	....	$0.74	....	$0.75

:2, with concentrates at $40.56, silage at $5.35, and dry forage at ɔer ton, and labor at 28 cents per hour, the average loss was ɜr cow. In that year there was an average increase in the market cows of $1.61 per head. The loss per 100 pounds of milk sold was But that year, after all charges except labor were met, the returns ɪ cents per hour for all time spent on the enterprise, 2 cents more :921.

COST OF PRODUCTION AND LABOR INCOME

ms where the cost of producing milk is highest, the labor income ˌerator is lowest; and where the cost is lowest the labor income is The same factors that cause a high cost, such as an unfavor- of business, poor cows, and uneconomical feeding, also cause low or the business as a whole. The relation of these returns to the roducing milk is given in table 53:

E 53. RELATION OF COST OF MILK PRODUCTION TO LABOR INCOMES

cow cost per 100 ıds	1921 Average cow cost of milk per 100 pounds	1921 Average labor income	1921 Number of farms	1922 Average cow cost of milk per 100 pounds	1922 Average labor income	1922 Number of farms
ss.......	$1.82	+$784	31	$1.73	+$856	20
'.50.....	$2.31	+$341	35	$2.26	+$18	24
;.00.....	$2.75	-$28	34	$2.72	0	35
....	$3.83	-$269	25	$3.62	-$593	29

COST OF RAISING HEIFERS

vas a total of 934 heifers on 125 farms in 1921, an average of farm, of which 31 per cent were purebred. In 1922 there was 862 heifers on 108 farms, an average of 8.0 to the farm, of which t were purebred.

ɪrage age at which heifers freshened for the first time was 27.1 ɪr 1921 and 27.2 months for 1922. The numbers and values freshening at each age appears in table 54. The average value) for grades, $115.75 for purebreds, and $87.97 for all of the 1921; and in 1922, $66.79 for grades, $121.54 for purebreds, for all.

New York farms, the average cost of raising heifers until two ge was 123 per cent of their value at the time of freshening, er cent of the average value of all the cows on these farms. rs do not freshen at two years of age, the cost of raising until f freshening would approximate, on these 884 farms, from 140 cent of their value at the time of freshening. The average for cows purchased, on these farms, was $95 per head, and the ue of all cows in the inventories was $96 per head.

TABLE 54. HEIFERS FRESHENING FOR FIRST TIME

Age (months)	125 farms in 1921		108 farms in 1922	
	Number	Value	Number	Value
15	1	$ 90	....	....
17	1	50	....	....
18	8	995	....	....
19	1	100	....	....
20	....	....	2	$ 140
21	2	150	1	50
22	....	....	19	1,380
24	139	11,570	90	6,820
25	6	600	16	3,200
26	24	1,980	18	1,270
27	20	1,500	44	3,415
28	5	315	3	180
30	104	9,805	90	6,005
32	2	120	....	....
33	....	....	3	225
34	1	85	....	....
36	28	2,725	20	1,410
42	....	....	2	200
Total	342	$30,085	308	$24,295

The activity of the cow market is influenced by price conditions for cash crops as well as for milk. If the prices of hay, cabbage, potatoes, peas, and other crops are low, so that the income from the crop sales is small, fewer cows are purchased, and less willingness to bid up the price is shown. When feed prices are high and milk is low, the same situation exists. One of the things that dairymen who replace their cows by purchase can do is to borrow, if necessary, in order to replace when cows are cheap, and thus possibly be able to sell some when cows are high, or at least to escape the necessity of replacing a large share of the dairy when cow markets are more active.

In 1921, 34.5 per cent of the cows were purchased and 65.5 per cent raised. In 1922 the proportions were 34.2 per cent purchased and 65.8 per cent raised. The average cost for two years of raising heifers was $111 in 1921 and $93 in 1922. In herds with fall-fresh cows, the cost was higher than in herds of spring-fresh cows, where the calves are started in the spring. Since the average age at freshening was about 27 months, the cost of raising until freshening would be approximately $125 for 1921 and $105 for 1922.

The average amounts of feed used per cattle unit of heifers each year are given in table 55. The average amount of whole milk used per cattle unit of heifers was 841 pounds in 1921 and 818 pounds in 1922. Because of the large proportion of purebred heifers, this is higher than the amounts used in other areas reported in previous bulletins. The average amount of grain was 807 pounds per cattle unit in 1921 and only 533 pounds per cattle unit in 1922. This is rather liberal grain feeding. The amount of silage averaged from 2 to 2.5 tons per cattle unit, and the hay approximately 2 tons per cattle unit.

TABLE 55. Cost of Raising Heifers

	125 farms in 1921				108 farms in 1922			
	Total		Unit of quantity	Amount per cattle unit	Total		Unit of quantity	Amount per cattle unit
	Amount	Value			Amount	Value		
Costs:								
Whole milk	392,848 pounds	$ 9,395	Pounds	841	353,168 pounds	$8,449	Pounds	818
Skimmilk, purchased	64,500 pounds	75	Pounds	138	100,000 pounds	200	Pounds	23
Skimmilk, farm	4,000 pounds	10	Pounds	9	......	......	......	......
Grain	3,767 cwt.	6,773	Pounds	807	2,302 cwt.	4,552	Pounds	533
Silage	1,204 tons	6,251	Pounds	5,156	930 tons	4,959	Pounds	4,306
Other succulent feed	27 tons	149	Pounds	116	......	......	Pounds	......
Hay	997 tons	14,202	Pounds	4,270	844 tons	9,693	Pounds	3,907
Other dry forage	37 tons	228	Pounds	158	2 tons	20	Pounds	9
Pasture	......	3,878	......	......	......	2,815	......	......
Bedding	106.7 tons	723	Pounds	457	87 tons	579	Pounds	403
Human labor	22,234 hours	5,862	Hours	48	28,229 hours	7,811	Hours	65
Horse labor	3,632 hours	577	Hours	8	4,841 hours	859	Hours	11
Use of buildings	......	3,260	......	......	......	2,987	......	......
Use of equipment	......	1,045	......	......	......	442	......	......
Interest on stock	......	2,595	......	......	......	2,419	......	......
Miscellaneous	......	445	......	......	......	......	......	......
Total costs	......	$55,468	......	......	......	$45,785	......	
Returns:								
Manure	3,715 tons	$ 6,679	Tons	8.0	3,262 tons	$ 5,579	Tons	7.6
Appreciation (net)	......	33,899	......	......	......	26,736	......	......
Miscellaneous	......	30	......	......	......	......	......	......
Total returns	......	$40,608	......	......	......	$32,315	......	......

Difference (loss)	......	$14,860	......	......	......	$13,470	......	......
Value at birth, and purchases, less sales and hides and those eaten	......	$3,059	......	......	......	-$95	......	......
Cost of raising heifers to two years of age:								
Total	......	$51,848	......	......	......	$40,111	......	......
Per cattle unit	......	$111.02	......	......	......	$92.85	......	......
Number of cattle units	......	467	......	......	......	432	......	......

A large proportion of the animals in this region are raised. In 1921 the silage and dry forage used by young cattle would have supported approximately 350 cows. If these cows were fed as much concentrates as was the average cow in the area, it would have been necessary to purchase 85 tons of grain more than the young cattle used. A balance of the additional charges and additional credits had cows been kept in place of the young cattle, appears in table 56. Since these farmers have the ordinary Grade B market for milk and have plenty of leguminous roughage on which vigorous, well-grown young cattle can be raised, it would not pay to replace the herds by purchase. The apparent difference in favor of cows over young cattle is insignificant.

TABLE 56. APPROXIMATE ADDITIONAL COSTS AND RETURNS IF 350 COWS WERE KEPT INSTEAD OF 467 CATTLE UNITS OF HEIFERS, IN 1921

Additional costs:	
Depreciation on, and loss due to death of, cows ($100 less $40 x 70)	$4,200
Concentrates in excess of amount used by young cattle (1697 cwt. at $38.76)	3,289
Labor in excess of that spent on young cattle (29,426 hours at 25 cents an hour)	7,356
Total	$14,845
Decreased costs:	
Interest	$461
Net additional cost	$14,384
Additional returns:	
Milk used by heifers that could be sold	$ 9,405
Milk receipts from 350 cows	47,604
Calves sold	1,186
Total	$58,195
Decreased returns:	
Appreciation on heifers	$33,899
Net additional returns	$24,296
Net approximate difference between additional costs and additional returns in favor of keeping cows:	
Total	$9,912
Per farm	$79

FALL OR SPRING FRESHENING

The variation in practice with respect to the time when the cows freshen is shown in table 57. Three groups were made of the records each year, one to include farms with less than 25 per cent of the cows freshening from September to December inclusive, one to include farms with from 25 to 50 per cent, and one to include farms with over 50 per cent. The tendency appears to be toward more fall freshening. In 1921, 45 per cent of the cows freshened from September to December inclusive, and in 1922, 50 per cent.

TABLE 57. COWS FRESHENING BY MONTHS

	All herds		Per cent of cows freshening from September to December inclusive					
			Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
	125 farms in 1921							
May	149	6.4	50	9.7	78	8.1	21	2.4
June	49	2.1	18	3.5	22	2.3	9	1.0
July	28	1.2	7	1.4	14	1.5	7	0.8
August	54	2.3	11	2.1	25	2.6	18	2.1
September	231	9.9	6	1.2	82	8.6	143	16.5
October	343	14.7	10	1.9	113	11.8	220	25.4
November	287	12.3	11	2.1	96	10.0	180	20.8
December	199	8.5	6	1.2	102	10.7	91	10.5
January	140	6.0	35	6.8	73	7.6	32	3.7
February	187	8.0	66	12.9	84	8.8	37	4.3
March	349	14.9	159	30.9	137	14.3	53	6.1
April	321	13.7	135	26.3	131	13.7	55	6.4
Total	2,337	100.0	514	100.0	957	100.0	866	100.0
	108 farms in 1922							
May	85	4.2	22	9.0	43	5.5	20	2.0
June	45	2.2	5	2.0	27	3.5	13	1.3
July	32	1.6	3	1.2	20	2.6	9	0.9
August	58	2.9	1	0.4	19	2.4	38	3.8
September	230	11.4	1	0.4	82	10.5	147	14.8
October	323	16.0	4	1.6	90	11.6	229	23.1
November	247	12.3	8	3.3	70	9.0	169	17.0
December	198	9.8	8	3.3	69	8.9	121	12.2
January	165	8.2	17	6.9	70	9.0	78	7.9
February	172	8.5	39	15.9	87	11.2	46	4.6
March	241	12.0	56	22.9	118	15.2	67	6.8
April	219	10.9	81	33.1	82	10.6	56	5.6
Total	2,015	100.0	245	100.0	777	100.0	993	100.0

In 1921 the average number of cows per farm in fall-fresh dairies was practically the same as in dairies where more of the cows freshened in the spring. The capital per farm was higher, and the production per cow was 580 pounds more. The cost of milk was practically the same, and the price averaged the same as on farms with spring-fresh cows. The average labor income was $325 per farm with largely spring-fresh herds, and $171 per farm with fall-fresh herds, being higher, therefore, on the farms with the larger proportion of spring-fresh cows (table 58).

In 1922 the production per cow was 495 pounds more in herds with a larger proportion of fall-fresh cows than of spring-fresh cows.

TABLE 58. RELATION OF SEASON OF FRESHENING TO VARIOUS FACTORS

	Per cent of cows freshening from September to December inclusive			All herds
	Less than 25 per cent	From 25 to 50 per cent	More than 50 per cent	
In 1921:				
Number of farms	27	49	49	125
Number of cows	517	991	867	2375
Cows per farm	19.1	20.2	17.7	19.0
Average capital per farm	$14,386	$15,840	$15,444	$15,371
Average labor income per farm	+$325	+$233	+$171	+$228
Pounds of milk produced per farm	121,303	130,321	122,348	125,248
Pounds of milk produced per cow	6,335	6,444	6,915	6,592
Weight of cows (pounds)	981	996	961	979
Per cent of milk sold from November to April	44.4	51.3	59.5	53.0
Butter fat test of milk (per cent)	3.40	3.39	3.37	3.38
Per cent of cows freshening from September to December inclusive	6.4	41.1	73.2	45.4
Cost of milk per 100 pounds	$2 46	$2.59	$2.42	$2.50
Price received per 100 pounds	$2.18	$2.20	$2.16	$2.18
In 1922:				
Number of farms	14	37	57	108
Number of cows	240	804	1,022	2,066
Cows per farm	17.1	21.7	17.9	19.1
Average capital per farm	$14,464	$17,068	$14,903	$15,588
Average labor income per farm	-$127	+$30	+$19	+$4
Pounds of milk produced per farm	102,127	136,589	115,675	121,083
Pounds of milk produced per cow	5,957	6,286	6,452	6,330
Weight of cows (pounds)	996	1,005	954	977
Per cent of milk sold from November to April	36.2	48.7	54.0	50.0
Butterfat test of milk (per cent)	3.40	3.38	3.37	3.38
Per cent of cows freshening from September to December inclusive	8.6	40.0	67.1	49.5
Cost of milk per 100 pounds	$2.74	$2.48	$2.55	$2.54
Price received per 100 pounds	$2.03	$2.20	$2.24	$2.19

The average labor income with spring-fresh cows was −$127 per farm in 1922, and with largely fall-fresh cows, +$19 per farm. The cost of producing milk was slightly less, and the price higher, in the fall-fresh herds than in the spring-fresh herds. The economic conditions for 1922 seemed to favor winter dairying more than in 1921.

In 1921 the returns per hour of man labor over all other costs were 13.9 cents for summer dairies and 16.3 cents for winter dairies. In 1922 they were 5.2 cents for summer dairies and 17.7 cents for winter dairies. (Tables 59 and 60.) Therefore the time spent in winter dairies was more profitable in each year.

TABLE 59. COSTS AND RETURNS FOR THREE SEASONAL GROUPS IN 1921

	Per cent of cows freshening from September to December inclusive					
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Per cow	Per 100 pounds of milk sold whole-sale	Per cow	Per 100 pounds of milk sold whole-sale	Per cow	Per 100 pounds of milk sold whole-sale
Costs:						
Feed	$83.06	$1 37	$92.76	$1.53	$94 54	$1.44
Pasture	8.55	0 14	8 86	0 15	9.84	0.15
Bedding	1.93	0.03	1 51	0 02	1.73	0 03
Human labor	34 21	0.57	37 82	0 62	39.32	0.60
Horse labor	1.56	0.03	1 92	0.03	1.62	0.02
Hauling milk	17.12	0.28	13.55	0 22	15.90	0.24
Use of buildings	5.64	0 09	8.19	0.14	7.59	0.12
Use of equipment	1.24	0.02	1.65	0.03	1.56	0.02
Interest on cows	5.36	0.09	6.61	0.11	5.96	0.09
Depreciation on cows	4.57	0.08	3.80	0 06	0 99	0.01
Bull service	2 74	0.05	3.49	0.06	3.67	0.06
Miscellaneous	3.18	0.05	4.07	0.07	3.98	0.06
Total costs	$169.16	$2.80	$184 23	$3.04	$186.70	$2.84
Returns:						
Milk sold wholesale:						
Cash	$124 79	$2 07	$126.85	$2 10	$134.60	$2.05
Certificates of indebtedness	6.55	0.11	6 31	0.10	7.46	0.11
Milk products sold and milk retailed	. .	. . . . .	0.22	. . . .	. . . . . .	. . . . . .
Milk and milk products used	5.80	0 09	8 71	0.15	7.83	0.12
Calves and calf hides	2 28	0 04	3.68	0.06	3.72	0.06
Manure	12.64	0.21	14.76	0.24	15.76	0.24
Miscellaneous	. . . . .	. . . .	0.15	. . . . .	0.04	. . . . . .
Total returns	$152.06	$2.52	$160.68	$2.65	$169.41	$2.58
Loss	$17.10	$0.28	$23.55	$0.39	$17.29	$0.26
Returns per hour of human labor above all other costs	. . . . .	$0.139	. . . . .	$0.118	. . . . . .	$0.163

The chief difference in cost between summer and winter dairies is in the cost of barn feed and that of labor, both being higher for the winter dairies.

TABLE 60. COSTS AND RETURNS FOR THREE SEASONAL GROUPS IN 1922

	Per cent of cows freshening from September to December inclusive					
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale
Costs:						
Feed	$84.61	$1.50	$75.94	$1.27	$84.00	$1.38
Pasture	8.03	0.14	8.86	0.15	8.01	0.13
Bedding	1.60	0.03	1.53	0.02	1.85	0.03
Human labor	42.21	0.75	40.53	0.68	46.09	0.76
Horse labor	3.05	0.05	3.53	0.06	4.01	0.06
Hauling milk	17.01	0.30	13.55	0.23	12.79	0.21
Use of buildings	7.65	0.14	6.29	0.11	7.07	0.12
Use of equipment	0.57	0.01	0.68	0.01	0.97	0.02
Interest on cows	6.08	0.11	6.00	0.10	6.14	0.10
Depreciation on cows	1.24	0.02	7.30	0.12	0.96	0.02
Bull service	3.35	0.06	4.59	0.08	3.61	0.06
Miscellaneous	2.59	0.04	2.76	0.05	3.57	0.06
Total costs	$177.99	$3.15	$171.56	$2.88	$179.67	$2.95
Returns:						
Milk sold wholesale:						
Cash	$108.91	$1.93	$126.19	$2.12	$131.60	$2.17
Certificates of indebtedness	5.91	0.10	4.67	0.08	4.17	0.07
Milk products sold and milk retailed	......	......	......	......	0.14	......
Milk and milk products used	6.56	0.12	7.47	0.12	8.21	0.13
Calves and calf hides	2.86	0.05	3.32	0.06	3.81	0.06
Manure	13.66	0.24	12.96	0.22	12.56	0.21
Miscellaneous	0.01	......	0.15	......	0.07	......
Total returns	$137.91	$2.44	$154.76	$2.60	$160.56	$2.64
Loss	$40.08	$0.71	$16.80	$0.28	$19.11	$0.31
Returns per hour of human labor above all other costs	......	$0.052	......	$0.172	......	$0.177

Of all the cows included in 1921, 47.6 per cent were less than five years old. Of all those in 1922, 43.8 per cent were less than five years old. In 1921, 10 per cent of the cows, and in 1922, 13.8 per cent of the cows, were over eight years old (table 61). The age of the cows in this region is approximately the same as in other regions covered by this investigation. In general, mature cows yield the heaviest and produce milk the cheapest. The larger proportion of the herd that can be maintained at mature age, the higher will be the yield. This will result in a lowered cost of production.

TABLE 61. AGE OF COWS ON HAND APRIL 30

Age (years)	Per cent of cows freshening from September to December inclusive						All herds	
	Less than 25 per cent		From 25 to to 50 per cent		More than 50 per cent			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
	125 farms in 1921							
2– 3	65	12.1	137	13.7	116	13.3	318	13.2
3– 4	95	17.7	154	15.3	167	19.1	416	17.2
4– 5	71	13.3	195	19.4	149	17.1	415	17.2
5– 6	96	17.9	175	17.4	166	19.0	437	18.1
6– 7	82	15.3	141	14.1	121	13.8	344	14.2
7– 8	55	10.3	105	10.5	83	9.5	243	10.1
8– 9	31	5.8	43	4.3	33	3.8	107	4.4
9–10	19	3.5	23	2.3	15	1.7	57	2.4
Over 10	22	4.1	30	3.0	24	2.7	76	3.2
Total	536	100.0	1,003	100.0	874	100.0	2,413	100.0
	108 farms in 1922							
2– 3	43	18.8	123	15.2	139	13.8	305	14.9
3– 4	32	14.0	108	13.4	149	14.8	289	14.1
4– 5	36	15.7	115	14.2	152	15.1	303	14.8
5– 6	36	15.7	137	16.9	143	14.2	316	15.5
6– 7	30	13.1	130	16.1	163	16.2	323	15.8
7– 8	23	10.1	89	11.0	115	11.4	227	11.1
8– 9	19	8.3	48	5.9	82	8.2	149	7.3
9–10	3	1.3	28	3.5	19	1.9	50	2.5
Over 10	7	3.0	31	3.8	44	4.4	82	4.0
Total	229	100.0	809	100.0	1,006	100.0	2,044	100.0

The variations in labor income and in the cost of producing milk in summer and fall dairies for the two years are shown in tables 62 and 63.

On 22, or 17.6 per cent, of the farms studied in 1921, and on 12, or 11.1 per cent, of the farms studied in 1922, the labor incomes were over $1000. In 1921, 50 farms, or 40 per cent, failed to make interest. In 1922, 48 farms, or 44.4 per cent, failed to make interest. In the two years, of the 34 farms that made labor incomes of over $1000, 16, or about half, had over 50 per cent of the cows freshening from September to December inclusive.

About half of the farms in the year 1921 produced milk at less than $2.50 per 100 pounds, and in 1922, 40 per cent of the farms, or slightly less than half, produced milk at a cost of less than $2.50 per 100 pounds.

TABLE 62. VARIATIONS IN LABOR INCOMES

Per cent of cows freshening from September to December inclusive	Number of farms making labor incomes as designated				
	Minus $500 or more	Minus $499 to $0	Plus $1 to plus $500	Plus $501 to $1000	Over $1000
1921.					
Less than 25 per cent. .	1	8	7	8	3
From 25 to 50 per cent.	10	12	11	7	9
More than 50 per cent...	13	6	15	5	10
All herds . . .	24	26	33	20	22
1922:					
Less than 25 per cent. ..	4	3	4	2	1
From 25 to 50 per cent.	12	3	8	9	5
More than 50 per cent...	16	10	16	9	6
All herds. . .	32	16	28	20	12

TABLE 63. VARIATIONS IN COST OF PRODUCING MILK

Per cent of cows freshening from September to December inclusive	Number of farms with cow cost of milk per 100 pounds sold wholesale as designated					
	Less than $2.50	$2.50 to $3.00	$3.01 to $3.50	$3.51 to $4.00	$4.01 to $4.50	Over $4.50
1921:						
Less than 25 per cent . . .	11	10	5	. . . .	1	. . . . . .
From 25 to 50 per cent. .	26	13	3	4	1	2
More than 50 per cent. .	26	14	4	. . .	2	3
All herds.	63	37	12	4	4	5
1922:						
Less than 25 per cent. ..	4	5	2	2	. . . .	1
From 25 to 50 per cent....	14	16	3	2	1	1
More than 50 per cent....	25	15	7	9	1	. . . . . .
All herds.	43	36	12	13	2	2

ORGANIZATION OF THE BUSINESS

SIZE OF THE BUSINESS

The farms in this area were laid out before dairying became the leading enterprise. It was shown in table 2 (page 6) that, of 218 farms in the town of Stockbridge, 63 contained less than 50 acres and only 21 contained 175 or more acres. For many operators in this town the chief problem in farm management is the development of a business of sufficient size to produce economically.

The variation in size of the business between the two years of survey is shown in table 64:

TABLE 64. COMPARISON OF THE VARIATION IN SIZE OF BUSINESS

Man equivalent	Cows per farm: Less than 18	From 18 to 30	More than 30	Total
	125 farms in 1921			
1 to 1.4	14	1	. .	15
1.5 to 1.9	14	4	. .	18
2.0 to 2.4	30	11	. .	41
2.5 to 2.9	4	11	3	18
3.0 and over	4	22	7	33
Total	66	49	10	125
	108 farms in 1922			
1 to 1.4	12	2	. .	14
1.5 to 1.9	19	4	. .	23
2.0 to 2.4	21	14	. .	35
2.5 to 2.9	3	9	3	15
3.0 and over	1	13	7	21
Total	56	42	10	108

The relation of the size of business, as measured by the number of cows per farm, to the cost of milk and to the labor income in each of the areas included in the study, is shown in table 65.

TABLE 65. RELATION OF SIZE OF BUSINESS, AS MEASURED BY NUMBER OF COWS, TO COST OF MILK AND TO LABOR INCOME

Number of cows per farm	Chenango County: 83 farms, condensery milk, Norwich;* crop year 1921	Chenango County: 84 farms, Grade A milk, Oxford;† crop year 1921	Onondaga and Cortland Counties: 51 farms, Grade A milk, Tully and Homer;‡ crop year 1921	Madison County: 125 farms, Grade B milk, Munnsville;§ crop year 1921	Madison County: 108 farms, Grade B milk, Munnsville;§ crop year 1922
	Average acres per farm				
Less than 18	114	110	126	106	109
18 to 30	174	189	184	169	168
Over 30	248	297	198	230	248
	Average capital per farm				
Less than 18	$8,333	$7,713	$12,703	$11,304	$11,404
18 to 30	$12,121	$12,015	$20,164	$18,618	$18,713
Over 30	$18,231	$20,623	$26,153	$26,292	$25,895

* Condensery milk without cash crops.
† Grade A milk without cash crops
‡ Grade A milk with cash crops.
§ Grade B milk with alfalfa roughage and some cash crops.

TABLE 65 (*concluded*)

Number of cows per farm	Chenango County		Onondaga and Cortland Counties	Madison County	
	83 farms, condensery milk, Norwich,* crop year 1921	84 farms, Grade A milk Oxford;† crop year 1921	51 farms, Grade A milk, Tully and Homer,‡ crop year 1921	125 farms, Grade B milk, Munnsville;§ crop year 1921	108 farms, Grade B milk, Munnsville;§ crop year 1922
	Average number of cows per farm				
Less than 18 .	14 4	13 7	14.3	12.7	13.1
18 to 30 ..	22.5	23 4	24.2	23.2	22.8
Over 30....	37 9	39.6	40 3	39.7	37.7
	Average labor income per farm				
Less than 18 .	+$36	+$318	+$781	+$171	-$56
18 to 30......	-$244	+$90	+$661	+$313	+$223
Over..	-$290	+$594	+$2,086	+$197	-$586
	Average labor income at pool prices per farm				
Less than 18 .	+$35	+$258	+$650	+$36	-$140
18 to 30. . .	-$277	+$23	+$383	+$77	0
Over 30.......	-$241	+$486	+$892	$69	-$760
	Average cow cost of milk per 100 pounds				
Less than 18...	$3.15	$2 96	$3.08	$2.55	$2.80
18 to 30..... .	$2.80	$2.73	$2.90	$2.41	$2.36
Over 30	$2 54	$2.34	$2.59	$2.64	$2.51
	Number of farms in groups				
Less than 18 ..	24	26	17	66	56
18 to 30... ...	33	35	21	49	42
Over 30	26	23	13	10	10

* Condensery milk without cash crops.
† Grade A milk without cash crops.
‡ Grade A milk with cash crops.
§ Grade B milk with alfalfa roughage and some cash crops.

The range in interest charges on the total capital in the business, the average interest charge, the average cash living costs, and the number of farms in each group, are given in table 66. More cash is paid out for living expenses on the larger farms. The labor income does not indicate the amount available to spend for living, as many farmers possess a sufficient equity in their business to enable them to live on a net income no larger than interest on capital. On farms with three times the capital of smaller places, the amount spent for living was nearly double per family. The families probably were larger, but the standard of living was higher.

TABLE 66. RELATION OF CASH LIVING COSTS TO SIZE OF BUSINESS AS INDICATED BY INTEREST CHARGE

Range in interest on capital	1921			1922		
	Average interest charge	Average cash living costs	Number of farms	Average interest charge	Average cash living costs	Number of farms*
Less than $300....	$ 239	$ 594	4	$ 218	$ 605	2
$300 to $600......	455	599	41	465	546	35
$601 to $900.......	737	732	41	739	651	35
$901 to $1,200....	1,026	878	24	996	750	16
$1,201 to $1,500....	1,348	1,026	11	1,320	976	12
Over $1,500......	1,691	1,144	4	1,605	1,075	4

*Cash living costs were not found on 4 farms.

USE OF MACHINERY

Efficiency in the use of farm machinery is particularly important at this time because of the low level of prices received for its products and the high cost of machinery, separate parts, and labor for repairs. Most of these farms can do the work cheaper without a tractor. The money had better be spent to make a part payment in the purchase of more land. On some farms, young persons are being deprived of an education, property is being mortgaged, and the future not only of the young persons but of the adults is being handicapped, by unnecessary and uneconomical expenditures for some kinds of machinery.

The labor incomes on these farms is less on farms with a high investment in machinery (table 67). Part of this is due to the unfavorableness of the years studied toward large business, and part is due to the high expenses on farms with a large investment in machinery.

TABLE 67. VARIATION IN THE AMOUNT OF CAPITAL IN MACHINERY AND LABOR INCOMES ON FARMS IN EACH GROUP

Value of machinery and equipment	1921		1922	
	Number of farms	Average labor income	Number of farms	Average labor income
Less than $500.............	26	+$231	16	+$448
$500 to $1,000..............	33	+$443	38	+$15
$1,001 to $1,500............	26	+$384	24	+$145
Over $1,500................	40	-$51	30	-$362

Of the 125 farms, 19 used trucks of the following makes: Ford 16, Chevrolet 1, International 2. Thirty farms had tractors of the following makes: Fordson 13, International 11, Avery 1, Heider 1, Huber 1, Case 1, LaCrosse 1, Happy Farmer 1.

TABLE 68. SUMMARY OF WORK UNITS

	Cattle	Other livestock	Cultivated crops	Grain crops and annual hay crops	Hay	Other crops	Miscellaneous	Total	Per cent on cattle	Per cent for each month
	125 farms in 1921									
1921:										
January	4,385	633	54	18	118	11	39	5,258	83.4	6.4
February	3,990	610	45	5	107	13	39	4,809	83.0	5.9
March	4,297	654	43	15	111	47	274	5,441	79.0	6.7
April	4,078	696	1,136	493	280	65	17	6,765	60.3	8.3
May	3,727	683	1,819	404	391	36	1	7,061	52.8	8.6
June	3,069	605	1,629	76	2,948	18	1	8,346	36.8	10.2
July	2,982	573	2,448	287	2,427	10	1	8,728	34.2	10.7
August	2,894	558	2,262	981	3,236	24	11	9,966	29.0	12.2
September	2,894	522	1,143	624	2,307	69	52	7,611	38.0	9.3
October	3,333	553	2,006	184	379	203	1	6,659	50.1	8.2
November	3,815	577	469	134	23	33	1	5,052	75.5	6.2
December	4,385	630	194	56	662	7	1	5,935	73.9	7.3
Total including labor on horses	43,849	7,294	13,248	3,277	12,989	536	438	81,631	...	100.0
Total omitting labor on horses	43,849	1,492	13,248	3,277	12,989	536	438	75,829	...	.
Per cent	57.8	2.0	17.5	4.3	17.1	0.7	0.6	100.0	.	.
	108 farms in 1922									
1922:										
January	4,042	536	55	11	98	11	38	4,791	84.4	6.7
February	3,678	516	46	3	88	13	32	4,376	84.0	6.1
March	3,961	558	47	11	93	37	128	4,835	81.9	6.7
April	3,759	592	978	416	237	62	112	6,156	61.1	8.6
May	3,436	583	1,465	328	331	54	3	6,200	55.4	8.6
June	2,830	518	1,547	102	2,706	37	3	7,743	36.5	10.8
July	2,749	488	2,360	267	2,026	19	3	7,912	34.7	11.0
August	2,668	475	1,178	735	2,629	33	23	7,741	34.5	10.8
September	2,668	445	984	457	1,401	66	22	6,043	44.2	8.4
October	3,072	470	1,895	141	321	195	4	6,008	51.1	8.4
November	3,517	488	463	105	17	32	4	4,626	76.0	6.4
December	4,042	533	159	46	560	6	11	5,357	75.5	7.5
Total including labor on horses	40,422	6,202	11,087	2,622	10,507	565	383	71,788	...	100.0
Total omitting labor on horses	40,422	1,186	11,087	2,622	10,507	565	383	66,772	...	...
Per cent	60.5	1.5	16.6	3.9	15.7	0.9	0.6	100.0	...	...

The following makes of milking machines were or had been in use on the 125 farms during the season of 1921: machines purchased in 1907, Hinman 1; in 1909, Hinman 1; in 1912, Hinman 2; in 1916, Hinman 3; in 1917, Hinman 4, Sharples 2; in 1918, Hinman 6, Universal 1, B.L.K.1; in 1919, Empire 4, Hinman 16, Pine Tree 1, Universal 1; in 1920, Empire 2, Hinman 10, Uebler 2, Sharples 2, Universal 1; in 1921, Hinman 3, Uebler 1, Perfection 1; in 1922, Uebler 1: a total of 66 machines. Of these, 9 had not been used during the year. The remaining 57 had been used as follows: January 48, February 48, March 47, April 48, May 47, June 47, July 39, August 33, September 38, October 45, November 45, December 46, a total of 531 months out of 684 months, or 78 per cent of the time. The summer dairies used their machines 82 per cent, and the winter dairies 71 per cent, of the time.

BALANCE OF THE BUSINESS

Labor distribution

The amount of man labor accomplished on these farms, in terms of work units of 10 hours each for 1921 and 1922, is shown in table 68. The actual time spent on cattle and the amount usually spent on crops was used. The distribution by months is made chiefly according to the data published in bulletin 414 of this station.[4]

In 1921, 57.8 per cent of the productive work was on cattle, 2.0 per cent on other livestock, 17.5 per cent on cultivated crops, 4.3 per cent on grain crops and annual hay crops, 17.1 per cent on hay, and 1.3 per cent on all else. In 1922, the apportionment of labor to the different divisions of the dairy enterprise was about the same as in the preceding year.

The distribution of the labor indicates that about one-third of it is performed in July, August, and September. The harvesting of cured and especially of the green alfalfa, accounts for most of the labor in these months.

Comparison of the apportionment of labor to various enterprises also is given in table 69. The smaller proportion of labor on cattle in this area than in the others, is due chiefly to the large amount of labor required in the harvesting of both cured and green alfalfa. The method of cutting only enough of the green alfalfa for one-, or at most two- or three-, days soiling results in a large amount of labor being required in this work of getting green feed to cows. Frequent cuttings are necessary because of the tendency of the crop to heat and mold. These numerous cuttings waste labor, however.

In table 70 is given a comparison of the monthly distribution of labor in this area with other systems of dairying previously reported, including intensive production without cash crops in the Norwich area, Grade A dairying without cash crops in the Oxford area, and Grade A production with intensive cultivated cash crops in the Tully and Homer area. The difference in the uniformity of distribution is conspicuous; a very uniform distribution is maintained with Grade A milk and cash crop production, and a decided rush occurs at the alfalfa harvest with the Grade B production with alfalfa roughage. Alfalfa furnishes more and better hay, but it also requires more labor per farm at a time of pressure in farm operations.

[4] Cost accounting for six years on some successful New York farms. By G. F. Warren and others. Cornell Univ. Agr. Exp. Sta., Bul. 414, 1923, p. 37-41.

TABLE 69. COMPARISON, BY AREAS, OF DISTRIBUTION OF LABOR

	Year ending April 30, 1922				Year ending April 30, 1923
	83 farms near Norwich, condensery milk without cash crops	84 farms near Oxford, Grade A milk without cash crops	51 farms near Tully and Homer, Grade A milk with cultivated cash crops	125 farms near Munnsville, Grade B milk with alfalfa roughage; hay as chief cash crop	108 farms near Munnsville, Grade B milk with alfalfa roughage; hay as chief cash crop
	Per cent of total productive man-work units				
Cattle	74.8	75.1	63.5	57.8	60.5
Other livestock (except horses)	1.5	2.1	1.5	2.0	1.8
Cultivated crops	8.0	8.5	19.3	17.5	16.6
Grain crops and annual hay crops	3.0	3.0	5.8	4.3	3.9
Hay	9.6	9.1	6.8	17.1	15.7
Other crops	0.3	0.3	0.8	0.7	0.9
Miscellaneous	2.8	1.9	2.3	0.6	0.6
Total	100.0	100.0	100.0	100.0	100.0

TABLE 70. COMPARISON, BY AREAS, OF MONTHLY DISTRIBUTION OF LABOR

	Year ending April 30, 1922				Year ending April 30, 1923
	83 farms near Norwich, condensery milk without cash crops	84 farms near Oxford, Grade A milk without cash crops	51 farms near Tully and Homer, Grade A milk with cultivated cash crops	125 farms near Munnsville, Grade B milk with alfalfa roughage; hay as chief cash crop	108 farms near Munnsville, Grade B milk with alfalfa roughage; hay as chief cash crop
	Per cent of total labor				
January	8.2	8.2	7.1	6.4	6.7
February	7.5	7.6	6.5	5.9	6.1
March	8.2	8.1	7.5	6.7	6.7
April	8.5	8.9	9.0	8.3	8.6
May	8.5	8.5	9.2	8.6	8.6
June	7.6	7.5	9.0	10.2	10.8
July	11.1	10.7	9.8	10.7	11.0
August	8.9	8.8	9.3	12.2	10.8
September	7.4	7.4	7.7	9.3	8.4
October	8.4	8.6	9.5	8.2	8.4
November	7.4	7.5	8.2	6.2	6.4
December	8.3	8.2	7.2	7.3	7.5
Total	100.0	100.0	100.0	100.0	100.0

In recent years, as the number of boys remaining at home on the farms has continuously decreased, farmers are cooperating more with their neighbors in haying, harvesting and threshing grain, silo filling, digging potatoes, and many other kinds of work. More can thus be accomplished with less hired labor, and the right kind of community spirit is promoted. One fault in the organization of such crews is sometimes evident: more help is used on the job than is needed, because of the limited number of machine outfits in the neighborhood or for other reasons.

Some idea of the great expenditure of energy in the care of dairy animals and the production of milk may be formed by the consideration of a few data. Taking as the yearly feed consumption of a cow, exclusive of pasture, one ton of concentrates, two tons of hay, and three tons of silage, then a rough approximation of the amount of human energy expended would appear as follows:

Concentrates: Loaded on wagon at mill, unloaded at barn, emptied into chute, fed to cow, or handled about four times, equal to 4 tons of lifting.

Hay: Loaded after hay loader, mowed away, pitched from mow, distributed to cows, a total of four times handled, or 8 tons of lifting.

Silage: Loaded on and off the wagon, distributed in silo, pitched out of silo, and fed to cows, a total of at least six times handled, or 18 tons of lifting.

Manure: Loaded on and off the wagon, a total of two handlings of about 8 tons per cow, or 16 tons of lifting.

Milk: Milked, and the night milk lifted into and out of vat, all of the milk lifted on the wagon and off, the handling of the empty can. This would require at least four liftings for about 2½ to 3 tons of milk per cow, or from 10 to 12 tons of lifting.

The total of all of this lifting is about 60 tons per cow. If the barn arrangement or the farm layout is inefficient, the amount of effort required will be increased. To arrive at the total expenditure of human energy for milk production, the indirect effort in fitting the land, growing the crops, caring for the work animals, and raising young cattle to replace the depreciation, must be added to this. The large expenditure of effort to obtain a quart of milk, altho well understood by the producer, is seldom fully appreciated by the consumer.

Fertility maintenance

The amounts of each kind of fertilizer used for each crop are shown in tables 71 and 72, and a summary of the amount purchased is given in table 73.

Of the total amount of fertilizer used, one-third was acid phosphate in each year, and in 1921 another third was of 2–8–2 and 2–8–4 brands; but in 1922 the amount of 2–8–2 and 2–8–4 was less, and nearly one-third of the fertilizer that year was 2–8–10. Commercial fertilizer was used in largest amounts for corn crops, and in next largest amounts for oats.

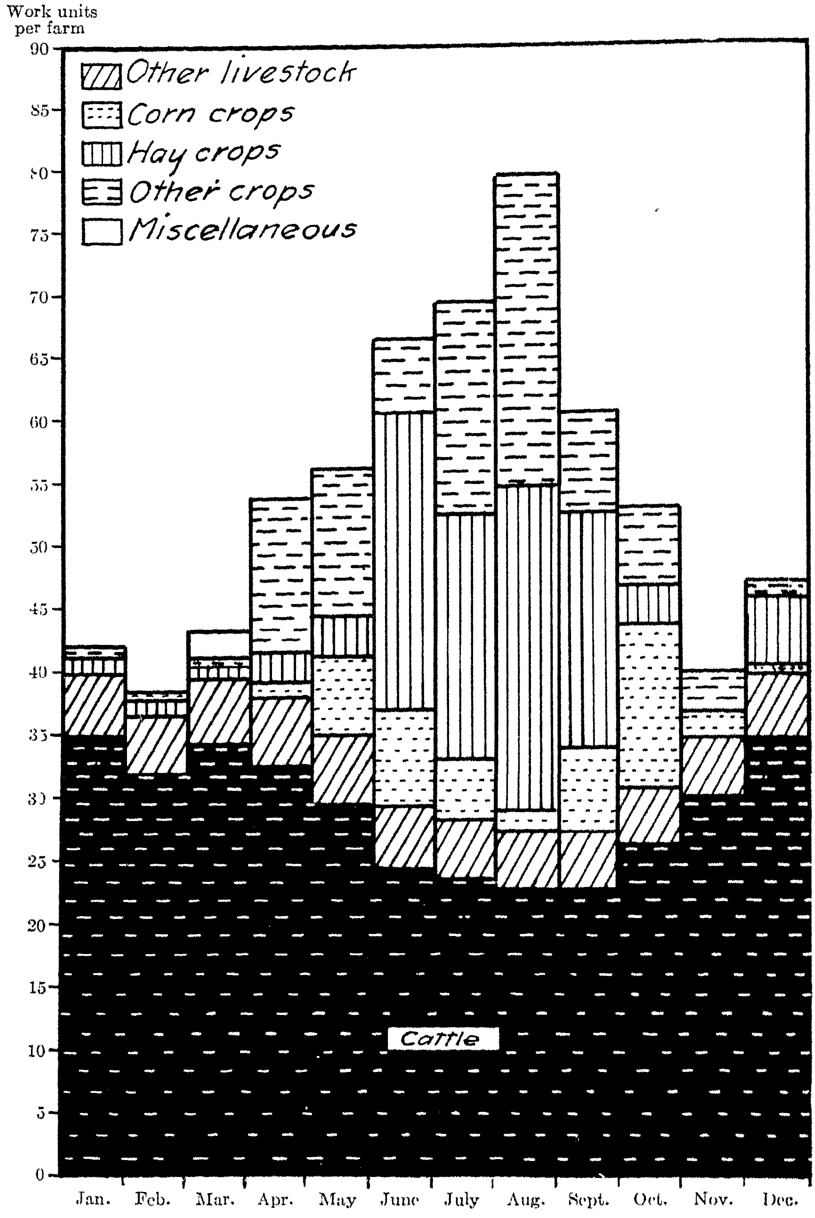

FIGURE 2. DISTRIBUTION OF MAN LABOR ON 125 FARMS IN 1921

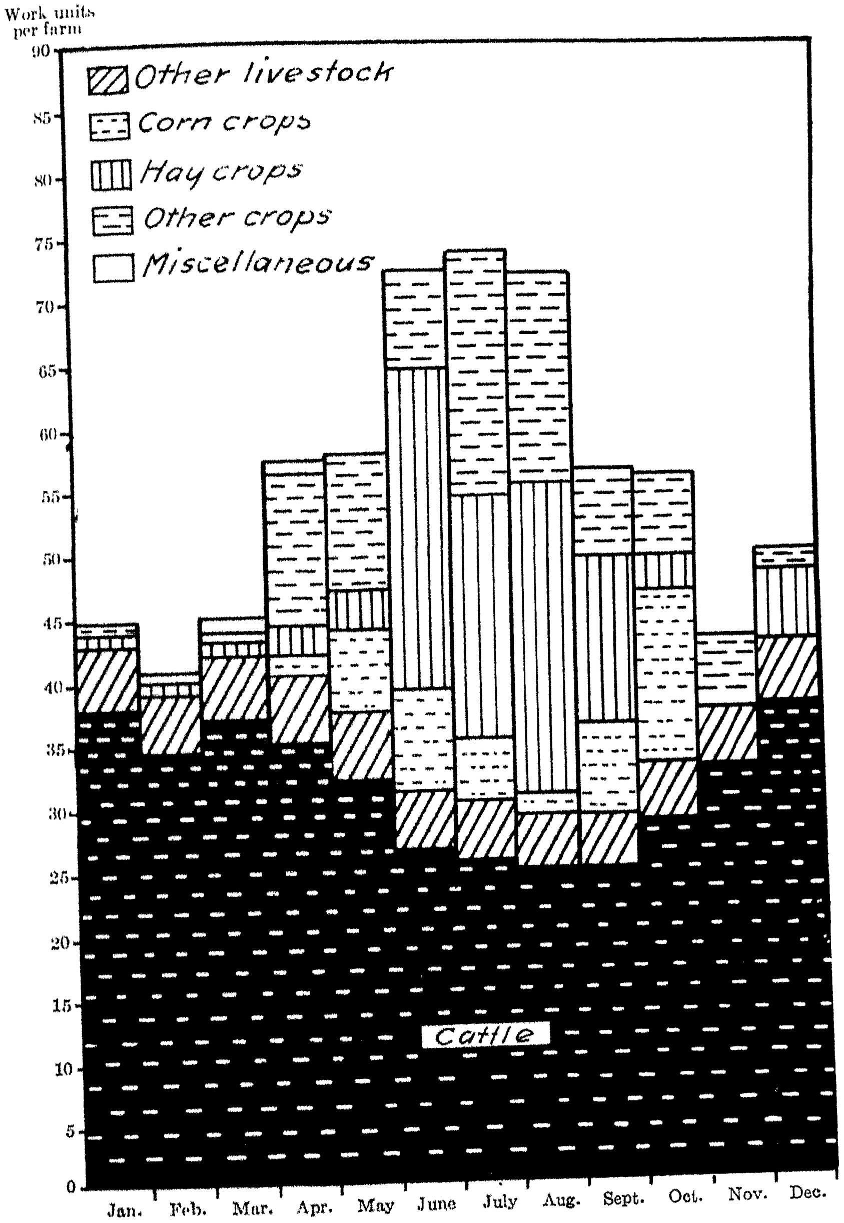

FIGURE 3. DISTRIBUTION OF MAN LABOR ON 108 FARMS IN 1922

TABLE 71. SUMMARY OF USE OF FERTILIZER AND LIME IN 1921

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Cost
For corn for grain:				
Acid phosphate	5	15	3,585	$54
Kainit	1	5	500	9
0-8-10	1	1	200	5
1-10-0	1	2	200	5
2-8-2	3	8	2,554	48
2-8-4	2	4	968	17
2-8-5	1	1	250	4
2-8-10	3	9	2,120	53
Total fertilizer	......	45	10,377	$195
For corn fed green:				
2-8-2	2	7	1,110	$21
For corn for fodder:				
2-8-10	1	2	500	$10
For corn for silo:				
Acid phosphate	13	126.5	28,265	$419
Kainit	1	15	1,500	28
0-8-10	1	9	1,800	43
1-6-10	1	4	1,000	16
1-8-1	1	4	1,000	16
1-8-2	2	13	2,700	52
1-8-4	2	9	1,500	34
1-9-2	1	7	1,200	15
2-4-8	1	5	1,000	18
2-8-2	13	116.5	23,751	479
2-8-3	1	16	4,500	90
2-8-4	10	86	20,478	380
2-8-5	3	27	4,650	83
2-8-6	3	16	4,500	101
2-8-10	7	55.5	12,385	272
2-10-0	1	6	1,400	28
3-6-10	1	5	2,000	37
3-8-2	1	4	1,000	22
4-8-5	1	7	1,050	29
6-8-0	1	2	500	15
Total fertilizer	......	533.5	116,179	$2,177
For corn for silo, surplus:				
Acid phosphate	1	5	1,250	$27
2-8-2	1	1	200	5
2-8-4	2	2	429	8
2-8-10	1	1	320	7
Total fertilizer	......	9	2,199	$47
For oats:				
Acid phosphate	17	133	27,600	$382
1-8-1	1	3	750	12
1-8-4	1	6	900	23
1-9-3	1	5	1,000	20

TABLE 71 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Cost
For oats (*concluded*):				
1-10-1	1	9	1,350	$ 25
2-8-2	14	114	19,481	317
2-8-3	1	10	3,000	60
2-8-4	6	58.5	10,750	200
2-8-5	1	4	500	11
2-8-6	3	19	4,100	91
2-8-10	7	60	12,750	247
4-8-5	1	10	2,000	55
Total fertilizer	......	431.5	84,181	$1,443
For oats for hay:				
Acid phosphate	1	7	1,925	$35
For oats and peas for hay:				
Acid phosphate	1	5	1,800	$25
For oats and barley:				
1-6-10	1	18	3,600	$59
2-8-2	1	6	1,500	16
2-8-4	1	8	1,930	31
Total fertilizer	......	32	7,030	$106
For oats, barley, and peas:				
Acid phosphate	1	18	3,600	$47
For barley:				
Acid phosphate	1	12	4,000	$63
1-10-1	1	5	1,000	18
2-8-2	1	3	375	7
2-8-10	1	8	1,600	29
Total fertilizer	......	28	6,975	$117
For buckwheat:				
1-6-10	1	2	200	$ 3
2-8-2	2	5	800	15
2-8-10	1	1	250	5
Total fertilizer	......	8	1,250	$23
For wheat:				
Acid phosphate	2	11	1,950	$ 27
1-8-4	1	5	1,000	20
2-8-2	12	60	11,869	203
2-8-4	1	12	3,200	61
2-8-6	1	5	1,000	22
2-8-10	4	17	3,000	54
4-8-5	1	8	1,600	44
Total fertilizer	......	118	23,619	$431
For alfalfa:				
2-8-2	1	8	1,100	$20

TABLE 71 (*concluded*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Cost
For potatoes:				
Acid phosphate	6	4.8	2,500	$38
1–6–10	1	2	3,200	52
1–8–4	1	0.5	200	5
1–9–2	1	1	500	10
1–10–0	1	0.5	375	7
2–8–2	3	4	1,150	21
2–8–3	1	3	900	18
2–8–4	4	3	2,125	41
2–8–6	1	0.5	250	4
2–8–10	3	3	975	23
2–10–0	1	2	600	12
3–8–2	2	0.7	350	7
Total fertilizer	.....	25.0	13,125	$238
For cabbage:				
Acid phosphate	1	3	2,000	$30
For peas:				
Acid phosphate	7	114	33,600	$521
2–8–2	6	26	6,500	133
2–8–4	1	10	2,000	38
2–8–5	1	4	500	11
2–8–6	3	11.5	3,150	57
2–8–10	3	9	2,600	47
3–8–2	1	2	500	11
3–8–6	1	5	500	5
Total fertilizer	......	181.5	49,350	$823
For hops:				
2–8–3	1	14	5,600	$112
For beets:				
Acid phosphate	1	0.7	400	$6
For garden:				
Acid phosphate	1	0.5	200	$3

TABLE 72. SUMMARY OF USE OF FERTILIZER AND LIME IN 1922

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Cost
For corn for grain:				
2–8–3	1	2	500	$10
2–8–10	2	5	1,000	19
Total fertilizer	......	7	1,500	$29

TABLE 72 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Cost
For corn fed green:				
2-8-10	2	2	610	$12
For sweet corn:				
4-8-4	1	3	600	$11
For corn for silo:				
Acid phosphate	13	134	39,125	$472
0-10-8	2	17	2,250	44
1-8-2	1	5	2,000	30
1-8-4	1	6	1,000	18
1-8-10	1	7	1,200	19
2-8-2	7	48	8,325	145
2-8-3	1	18	4,500	95
2-8-4	3	26	7,600	140
2-8-10	15	143	31,190	579
2-9-4	1	11	2,000	42
3-8-2	1	4	1,000	18
3-8-6	1	5	1,500	30
4-8-4	2	13	2,500	47
Kinds not found	2	25	3,103	61
Total fertilizer	..	462	107,293	$1,740
Ground limestone	1	6	500	$2
For oats:				
Acid phosphate	15	110	26,078	$338
0-10-8	1	8	1,500	27
0-12-4	1	4	1,000	17
1-8-3	1	14	1,750	31
2-8-2	8	69	11,820	208
2-8-4	2	15	2,400	47
2-8-5	1	14	1,750	31
2-8-10	8	76	14,525	264
4-8-4	1	6	1,000	20
Kinds not found	1	15	2,002	39
Total fertilizer	......	331	63,825	$1,022
Ground limestone	1	5	1,000	$3
For oats and barley:				
Acid phosphate	1	6	1,500	$17
1-8-4	1	12	2,400	38
1-8-5	1	12	2,400	40
1-8-10	1	11	1,900	31
2-8-10	2	14	2,800	53
Total fertilizer	.....	55	11,000	$179
For oats, barley, peas, spring wheat, and buckwheat:				
1-8-4	1	6	2,000	$32
For speltz:				
Kinds not found	1	3	400	$8

TABLE 72 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilizer	Total pounds used	Cost
For barley:				
Acid phosphate	1	1	285	$4
For wheat, winter:				
0–10–8	1	5	1,500	$27
2–8–2	6	22	3,365	60
2–8–10	4	39	5,500	99
Kinds not found	1	5	665	13
Total fertilizer	..	71	11,030	$199
For wheat, spring:				
Acid phosphate	1	2	400	$5
For alfalfa:				
Ground limestone	1	8	20,000	$40
For hay, new seeding:				
Ground limestone	1	5	10,000	$40
For potatoes:				
Acid phosphate	5	5	2,216	$29
2–8–2	3	2	750	12
2–8–5	1		300	6
2–8–10	7	12	6,300	123
3–8–6	1	4	800	16
Kinds not found	1	2	230	5
Total fertilizer	.....	25	10,596	$191
For market peas:				
Acid phosphate	4	29	10,400	$124
0–10–8	1	1	250	3
2–8–2	1	10	3,330	58
2–8–3	1	8	2,800	59
2–8–10	6	60	16,100	280
3–8–6	2	19	5,700	117
Total fertilizer	.....	127	38,580	$641
For factory peas:				
Acid phosphate	3	17	6,666	$69
2–8–2	3	7	1,510	26
2–8–10	3	21	3,600	68
4–8–4	1	7	1,400	27
Kinds not found	1	2	600	12
Total fertilizer	.....	54	13,776	$202
For beans:				
Acid phosphate	1	7	1,930	$20
2–8–10	2	9.5	4,525	78
Total fertilizer	......	16.5	6,455	$98

TABLE 72 (*concluded*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Cost
For cabbage:				
Acid phosphate	2	5	2,500	$29
2–8–3	1	2	400	8
2–8–10	1	2	1,000	19
3–8–6	1	4	800	17
Total fertilizer	....	13	4,700	$73
For hops:				
2–8–3	1	9	1,800	$38

TABLE 73. SUMMARY OF FERTILIZER AND LIME PURCHASED

	1921		1922	
	Pounds used	Per cent of total	Pounds used	Per cent of total
Fertilizer:				
Acid phosphate	112,675	33.9	91,100	33.2
Kainit	2,000	0.6	....	....
0–8–10	2,000	0.6	....	....
0–10–8	....	....	5,500	2.0
0–12–4	....	....	1,000	0.4
1–6–10	8,000	2.4	....	....
1–8–1	1,750	0.5	....	....
1–8–2	2,700	0.8	2,000	0.7
1–8–3	....	....	1,750	0.6
1–8–4	3,600	1.1	5,400	2.0
1–8–5	....	....	2,400	0.9
1–8–10	....	....	3,100	1.1
1–9–2	1,700	0.5	....	....
1–9–3	1,000	0.3	....	....
1–10–0	575	0.2	....	....
1–10–1	2,350	0.7	....	....
2–4–8	1,000	0.3	....	....
2–8–2	70,390	21.2	29,100	10.6
2–8–3	14,000	4.2	10,000	3.6
2–8–4	41,880	12.6	10,000	3.6
2–8–5	5,900	1.8	2,050	0.8
2–8–6	13,000	3.9	....	....
2–8–10	36,500	11.0	87,150	31.7
2–9–4	....	....	2,000	0.7
2–10–0	2,000	0.6	....	....
3–6–10	2,000	0.6	....	....
3–8–2	1,850	0.6	1,000	0.4
3–8–6	500	0.1	8,800	3.2
4–8–4	....	....	5,500	2.0

TABLE 73 (*concluded*)

	1921		1922	
	Pounds used	Per cent of total	Pounds used	Per cent of total
Fertilizer (*concluded*):				
4–8–5	4,650	1.4	......	......
6–8–0	500	0.1	......	......
Kinds not found	......	.....	7,000	2.5
Total fertilizer	332,520	100 0	274,850	100.0
Lime	......	......	41,500	....

The average rates of application of fertilizer per acre fertilized were: for corn for the silo, 218 pounds in 1921, and 232 pounds in 1922; for oats, 195 pounds in 1921 and 193 pounds in 1922; for peas, 272 pounds in 1921; for market peas, 304 pounds in 1922; for wheat, 200 pounds in 1921; for winter wheat, 155 pounds in 1922. Since not all of the acreage of crops was fertilized, the averages for all acres would be less, and can be determined from tables 12, 13, 71, and 72.

As the soil in this region is naturally rich in limestone, no lime was used in 1921, and in 1922 only 20.8 tons was used. All the leguminous crops grow well in this region without any application of lime.

A balance between plant food removed and plant food returned to the soil was computed on the basis of the conditions set forth in bulletin 421 of this station.[5] The results are given in table 74 and indicate net losses of P_2O_5, K_2O, and CaO. The amount of nitrogen added by nodule fixation is based on the conjecture that it is equal to the amount in the tops of plants removed. On this assumption the nitrogen balance is well maintained because of the large amount of alfalfa hay. Nitrogen added by the roots of alfalfa is believed to be more available than some other forms.

The average amount spent for fertilizer on these farms was $47 per farm in 1921 and $43 per farm in 1922. The practice of using fertilizer needs to be carried on with precaution in a region such as this, where the nitrogen content of the soil is so well maintained by fixation. With the alfalfa sod plowed under for corn, it is questionable whether the use of a nitrogen-carrying fertilizer for corn for the silo is profitable. Fertilizer makes quack grass and weeds grow, as well as corn, and if its use is not followed by proper cultivation, money is wasted. The regular use of acid phosphate with the grain probably pays, because of the beneficial effect on the new alfalfa seedings. It also pays to use acid phosphate on peas.

[5] Economic studies of dairy farming in New York. I. Condensery milk without cash crops. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bul. 421, 1923, p. 66–67.

TABLE 74. FERTILITY BALANCE STATEMENT

	125 farms in 1921, with 7699 acres of crops, excluding orchard					108 farms in 1922, with 6617 acres of crops, excluding orchard				
	Pounds of plant food				Tons of organic matter	Pounds of plant food				Tons of organic matter
	N	P_2O_5	K_2O	CaO		N	P_2O_5	K_2O	CaO	
By removal in crops grown (total)	648,363	183,747	650,999	468,950	....	529,991	147,514	542,286	422,093	....
By removal per acre of crops, excluding orchard	84	24	85	61	....	80	22	82	64	....
By addition:										
Nodule fixation	479,926	....	....	....	....	411,767	....	....	....	....
Commercial fertilizer	3,492	35,341	10,361	48,576	....	2,956	29,446	12,305	40,489	....
Lime	....	....	....	....	....	....	....	....	23,240	....
Seed	6,212	1,951	2,093	236	111.2	5,714	1,707	1,950	210	97.8
Straw, hay, etc., for bedding	12,069	3,884	26,997	8,294	871.6	9,513	3,250	22,473	6,697	720.9
Dry forage fed *	215,459	61,827	219,323	177,243	3,523.3	183,220	52,737	187,470	151,525	2,985.6
Succulent feed fed *	45,886	24,714	57,535	25,577	1,282.6	37,255	19,828	45,922	20,474	1,023.2
Concentrates fed *	84,583	29,652	16,109	5,760	1,036.2	65,372	20,896	11,092	4,781	762.7
Amount added (total) †	847,627	157,369	332,418	265,686	6,824.9	715,797	127,864	281,212	247,416	5,590.2
Per acre	110	20	43	35	0.89	108	19	42	37	0.84
Removal less addition per acre †	+26	—4	—42	—26	....	+28	—3	—40	—27	....

* Feed supplementary to pasture excluded.

† When it is considered that 60 per cent of the N, 70 per cent of the P_2O_5, 60 per cent of the K_2O, 60 per cent of the CaO, and 45 per cent of the dry matter in feed, is returned in manure.

In the three bulletins of this series, results for four systems of dairy farming have been given; (1) condensery milk without cash crops, (2) Grade A milk without cash crops, (3) Grade A milk with cultivated cash crops, and (4) Grade B milk with alfalfa roughage, and hay as a cash crop. An approximation of the elements removed by crops per acre of crops, and of elements returned by fixation in fertilizer and lime, in manure, seed, and so forth, for each system, is given in table 75:

TABLE 75. COMPARISON, BY AREAS, OF PLANT-FOOD CONSTITUENTS REMOVED BY CROPS AND RETURNED TO THE SOIL

	Removed by crops per acre of crops				Added per acre					
					Nitrogen					
	N	P_2O_5	K_2O	CaO	By fixation	By other means	Total	P_2O_5	K_2O	CaO
Year ending April 30, 1922:										
83 farms near Norwich, condensery milk without cash crops.	36	13	47	16	6	33	39	16	31	59
84 farms near Oxford, Grade A milk without cash crops....	40	14	52	18	8	36	44	17	33	70
51 farms near Tully and Homer, Grade A milk with cultivated cash crops..............	55	10	64	29	20	41	61	28	39	141
125 farms near Munnsville, Grade B milk with alfalfa roughage, and hay as a cash crop	84	24	85	61	62	48	110	20	43	35
Year ending April 30, 1923:										
108 farms near Munnsville, Grade B milk with alfalfa roughage, and hay as a cash crop	80	22	82	64	62	46	108	19	42	37

The removal of elements is least with the first system and increases as the intensiveness of the system increases. The crop indexes for the four systems, in the order of their appearance in table 75, were 96, 103, 125, 100, and 98. The removal depends not only on the yield but also on the kinds, and therefore on the composition, of the crops grown. With the extensive condensery system, not only were the yields lower, but the kinds of crops grown were much lower in nitrogen and lime and slightly lower in potash than were crops in the Tully and Homer and the Munnsville areas.

The losses of elements from the soil are chiefly thru removal by crops and by leaching. In the case of lime particularly, and also to a less extent of potash, the largest losses are thru leaching. It must therefore be remembered, when inspecting table 75, that in the case of these two elements, altho additions may exceed the amounts removed by crops, this excess does not indicate that the amount added will also cover the amount lost thru percolation. In most cases it will not. Neither should it be concluded that additions equal to the amounts lost thru drainage and crop removal are necessary, because in the case of limestone soils, such as those in the vicinity of Munnsville, enough lime is contained in the soil to maintain an alkaline condition for years and at the same time furnish the small amounts of CaO contained in crops removed.

The difference between elements removed in crops grown with the various systems and elements added in all ways except in cattle manure is shown in table 76. This shows in one way the difficulty of maintaining the nitrogen with all systems except the one with alfalfa. The phosphoric acid and lime balance could be maintained cheaply by the application of acid phosphate and lime. Whether the potash deficiency would seriously limit crop yields is a question. Without cattle, only approximately one-sixth as much organic matter would be returned as with cattle. In short, the most serious difficulty in maintaining fertility without animals would be with the production of nitrogen and organic matter. With alfalfa the problem would be much less difficult.

TABLE 76. POUNDS OF FERTILIZING ELEMENTS REMOVED PER ACRE FROM THE SOIL BY CROPS AND ADDED BY MEANS OTHER THAN CATTLE MANURE WITH VARIOUS SYSTEMS OF DAIRYING

	83 farms near Norwich, 1921, condensery milk	84 farms near Oxford, 1921, Grade A milk	51 farms near Tully and Homer, 1921, Grade A milk	125 farms near Munnsville, 1921, Grade B milk	108 farms near Munnsville, 1922, Grade B milk
Removed by crops grown:					
Nitrogen	36	40	55	84	80
Phosphoric acid	13	14	19	24	22
Potash	47	52	64	85	82
Lime	16	18	29	61	64
Added in commercial fertilizer, lime, seed, bedding, and horse feed, and by fixation:					
Nitrogen	10	12	30	72	71
Phosphoric acid	5	5	17	8	7
Potash	5	5	15	11	11
Lime	43	65	129	11	14
Organic matter (tons)	0.13	0.14	0.28	0.24	0.23
Excess of removal over addition per acre:					
Nitrogen	+26	+28	+25	+12	+ 9
Phosphoric acid	+ 8	+ 9	+ 2	+16	+15
Potash	+42	+47	+49	+74	+71
Lime	−27	−47	−100	+50	+50

A statement of the use of manure made during the two years of survey is given in table 77. In 1921 an average of 221 tons of manure per farm, or 3.5 tons per acre of crops, was applied to crops. In 1922 an average of 209 tons per farm, or 3.3 tons per acre of crops, was applied. In 1921, 45 per cent, and in 1922, 54.4 per cent, was applied to the corn crop. Alfalfa received the next largest amount of manure. The average rate of spreading was 13.2 tons per acre manured in 1921, and 13.0 tons in 1922. The heaviest applications were made to cabbage, potato, and corn ground.

The question might be raised as to whether the most profitable use of manure is made when so much of it is put on corn ground. Since alfalfa obtains so much nitrogen from the air, the need for the stimulus to the alfalfa plant itself of the small amount of nitrogen contained in the manure would be relatively insignificant; but in most of these alfalfa fields, there is some other grass which, altho it benefits from the fixation in alfalfa, would probably produce a heavier sod if more applications of

TABLE 77. USE OF MANURE

	125 farms in 1921					108 farms in 1922				
	Number of farms using	Acres manured	Tons applied	Tons per acre manured	Per cent of tons applied	Number of farms using	Acres manured	Tons applied	Tons per acre manured	Per cent of tons applied
Corn for grain	23	72.0	1,093	15.2	3.9	7	30	526	17.5	2.3
Corn for fodder	4	12	293	24.4	1.1	1	1	17	17.0	0.1
Corn for silo	89	694	11,049	15.9	40.0	86	755	11,767	15.6	52.0
Oats	13	101	1,296	12.8	4.7	14	103	1,302	12.6	5.8
Buckwheat	1	3	45	15.0	0.2	....	....	....	....	....
Wheat	7	20	168	8.4	0.6	3	6	90	15.0	0.4
Barley	1	2	30	15.0	0.1	1	1	12	12.0	0.1
Alfalfa (not specified)	9	160	1,462	9.1	5 3	44	358.5	3,944	11 0	17.4
Alfalfa, first year	39	349.6	3,879	11.1	14.0	6	42	437	10 4	1.9
Alfalfa, other years	38	351	4,241	12.1	15.3	6	59	673	11.4	3 0
Hay, first year	12	74	770	10.4	2.8	8	84	690	8.2	3.0
Hay, old meadows	12	97	1,287	13.3	4.7	17	168	1,651	9.8	7.3
Sweet clover	....	....	....	....	....	1	12	108	9.0	0.5
Potatoes	20	21.3	322	15.1	1.2	17	19	322	16.9	1.4
Cabbage	3	4.5	65	14.4	0.2	4	9	175	19.4	0 8
Peas	6	25	307	12.3	1.1	5	37	384	10.4	1.7
Hops	4	45	501	11.1	1.8	1	9	81	9.0	0.4
Pasture	12	58	751	12.9	2.7	5	39	309	7.9	1.4
Other crops	....	1.2	81	....	0.3	....	5	120	....	0.5
Total	....	2,090.6	27,640	13.2	100.0	....	1,737 5	22,608	13.0	100 0
Not used	....	....	300	....	....	....	....	309	....	....
Corn for silo, pea refuse used	....	10	50	....	....	....	....	....	....	....

manure were made. Altho there is no evidence that it would pay better, the arguments seem to favor using a slightly smaller proportion of the manure on corn, and a larger proportion for top-dressing alfalfa meadows.

BUSINESS ANALYSES OF INDIVIDUAL FARMS

In table 78 is given a comparison of the total acres operated, acres of crops, number of cows, total capital, man equivalent, milk sales, crop sales, farm expenses, labor income, labor income on pool-price basis, cow cost of milk per 100 pounds, and pounds of milk produced per cow, for each of the years 1921 and 1922, for each farm. These data reflect the changes in the business on each farm during the two years.

The most successful farms for the two years are nos. 296, 322, 233, 220, 299, 271, 342, 309, 280, 263, 312, 256, 305, and 335. The reason for their success is a large dairy, a good dairy, high crop sales, or economical operation.

A few of the factors affecting the success of the farms, arranged according to the cost of milk in 1921, are given in table 79. The farms that had a low cost of milk production in 1921 tended to have a low cost in 1922 also, altho the cost in the succeeding year was not always proportionate to the cost in the first year.

The average costs of producing milk, on farms with the following production costs in 1921, were:

Cost $2.00 or less in 1921 — average cost in 1921 $1.82, in 1922 $2.48;
Cost $2.01 to $2.50 in 1921 — average cost in 1921 $2.31, in 1922 $2.45;
Cost $2.51 to $3.00 in 1921 — average in 1921 $2.75, in 1922 $2.70;
Cost more than $3.00 in 1921 — average in 1921 $3.83, in 1922 $3.11.

The average labor incomes of the farms in each of the four respective cost groups were as follows: first group (cost of milk in 1921 $2.00 or less), in 1921 +$784, in 1922 +$175; second group (cost of milk in 1921 from $2.01 to $2.50), in 1921 +$341, in 1922 +$75; third group (cost of milk in 1921 from $2.51 to $3.00), in 1921 −$28, in 1922 +$35; fourth group (cost of milk in 1921 more than $3.00), in 1921 −$269, in 1922 −$313.

TABLE 78. IMPORTANT BUSINESS FACTORS FOR DAIRY FARMS IN AN ALFALFA REGION FOR THE CROP YEARS OF 1921 AND 1922, ARRANGED ACCORDING TO SIZE OF BUSINESS OPERATED IN 1921

Farm no.	Acres operated		Acres of crops		Number of cows		Average total capital		Man equivalent		Milk sales		Crop sales		Current farm expenses		Labor income		Labor income on pool-price basis		Cow cost of milk per cwt.		Pounds of milk produced per cow	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
302...	43	....	34	....	9.7	...	$9,231	..	1.7	..	$1,907	.	$44	..	$1,770	...	$911	......	$1,059	....	$2.01	.	10,740	.
296...	45	45	29.5	22	10.0	10.5	8,290	$8,142	1.3	1.1	1,544	$1,454	1,815	$185	1,528	$1,232	1,902	$666	1,396	$617	3.10	$2.67	5,371	6,959
307...	46	......	23	.....	8.0	......	5,130	...	1.3	..	1,496	..	150	...	1,321	.....	481	.....	130	....	2.55	...	6,709	....
248...	49	147	23.5	53	12.5	18.5	3,998	7,795	1.8	1.8	1,062	1,987	....	95	2,142	1,582	—1,150	703	—1,150	703	3.21	2.55	5,225	5,455
236...	53	55.5	24.5	25.5	15.0	12.0	7,123	6,802	2.3	1.3	1,895	1,784	110	..	1,507	1,094	491	370	494	349	1.93	2.05	6,698	7,741
313...	54	.....	20	.....	14.5	....	12,898	...	1.6	...	2,139	..	10	..	1,891	.	—113	.....	—413	....	2.45	....	7,493	.
235...	55	55	31.8	30.8	13.0	10.5	8,892	8,566	2.1	1.6	1,595	1,030	146	314	1,379	1,370	113	—503	113	—503	2.72	3.90	6,525	5,187
232...	57	57	23.3	26	9.0	8.0	4,116	4,132	1.2	1.1	1,711	1,877	80	62	1,713	1,312	—22	415	—22	415	2.98	2.74	9,117	11,397
247...	58	58	27	33	10.5	11.5	9,080	9,182	1.3	1.7	1,832	2,153	76	56	1,034	1,877	783	—26	767	—244	1.67	3.76	8,865	7,905
323...	67	67	29	31.2	9.5	11.0	9,022	10,102	1.3	1.3	1,888	1,602	..	131	3,150	1,389	299	181	—78	13	2.44	2.15	8,641	6,667
311...	75	87	36.2	37	13.0	11.5	13,150	12,925	2.4	1.8	1,510	1,211	820	265	1,125	1,096	856	83	856	83	3.16	4.93	6,574	6,033
268...	77	77	43.5	41	13.5	13.5	13,352	13,221	2.2	2.1	1,611	1,272	927	303	1,671	1,701	21	—871	24	—871	2.59	2.31	5,687	4,887
330...	80	80	43.5	47	12.0	11.5	7,958	7,809	2.0	1.8	1,611	1,236	376	356	1,362	893	685	217	372	80	2.73	3.21	5,415	5,298
322...	80	80	36.5	43	9.0	11.5	7,061	7,215	2.0	2.1	1,345	1,506	301	1,070	1,091	1,591	897	881	602	729	1.75	2.31	6,521	5,812
295...	82	127	48.5	66	14.0	17.0	12,542	11,760	2.2	2.4	2,728	3,211	98	910	2,652	3,305	81	825	81	762	1.63	2.24	10,358	9,160
269...	83	83	35	34	13.0	14.0	12,212	12,078	2.2	2.4	1,890	1,815	310	244	2,811	2,100	90	—444	82	—641	2.12	1.76	7,669	5,694
231...	85	98	46	56	19.0	19.5	8,250	8,695	1.8	1.5	2,389	2,336	125	181	2,230	1,581	583	497	583	497	1.83	2.91	5,950	6,109
339...	85	85	46.5	50.5	14.0	13.8	12,150	11,038	2.0	2.0	2,102	1,960	3	155	1,035	1,974	426	—1,051	426	—1,051	1.74	2.99	7,717	7,029
294...	86	86	37.5	51	9.0	9.5	9,014	8,900	1.5	1.4	1,520	1,591	60	120	1,507	1,250	—531	—94	—782	—257	3.11	3.55	7,149	7,993
338...	87	87	57	47	9.5	12.0	8,031	8,235	2.0	1.7	1,248	1,618	90	255	[illegible]	1,774	83	407	71	256	2.41	3.68	7,010	6,259
320...	88	88.5	36.5	41.5	12.5	12.0	10,773	9,591	2.2	2.3	1,485	1,568	270	505	2,457	1,959	—130	313	—710	156	3.68	2.98	5,825	5,725
304...	90	90	34	34	10.0	10.5	6,695	6,635	1.7	1.8	1,225	1,140	137	193	1,577	1,568	70	—148	70	—148	3.49	2.58	6,128	6,434
298...	90	90	39.5	41	12.0	11.0	15,351	12,975	2.1	2.2	1,580	1,262	952	[illegible]	[illegible]	[illegible]	288	—1,455	103	—1,485	2.79	1.79	6,494	6,076
233...	90	90	44.2	44	21.0	20.0	11,915	13,918	2.1	1.7	3,555	2,953	...	163	[illegible]	[illegible]	1,279	1,147	553	829	2.14	2.01	6,612	6,537
221...	90	90	54.5	58	13.5	14.5	12,984	13,333	1.7	1.4	1,779	1,475	.	[illegible]	[illegible]	[illegible]	684	250	684	250	2.27	3.64	7,553	5,601
315...	90	90	50.5	53	14.0	13.5	11,944	[illegible]	2.2	1.9	1,313	1,555	507	638	[illegible]	[illegible]	55	—786	55	—786	2.11	2.76	6,601	5,722
285...	92	92	34.5	36.7	12.0	12.5	16,527	16,503	1.4	1.3	2,159	2,563	....	222	2,127	1,411	—558	426	—645	176	2.44	2.36	8,750	8,795
246...	92	92	48	39	19.0	19.0	[illegible]	[illegible]	2.9	2.8	3,951	3,158	357	[illegible]	[illegible]	[illegible]	—158	—141	—410	—141	1.96	2.23	[illegible]	8,327
300...	92	92	52	46.5	10.0	11.0	15,040	11,898	2.2	2.0	[illegible]	1,521	95	.	[illegible]	[illegible]	—259	—587	—259	—587	1.80	1.95	[illegible]	6,907
234...	93	93	29.5	41.5	20.5	17.0	12,534	12,000	1.6	1.6	[illegible]	[illegible]	12	155	[illegible]	[illegible]	69	207	69	207	2.18	2.33	8,187	6,831
310...	93	93	34.5	28.8	8.0	7.5	8,474	8,420	1.2	1.0	1,490	1,270	132	.	[illegible]	747	495	79	495	79	1.65	2.63	[illegible]	8,712
220...	96	96	47.5	47	19.5	18.0	7,618	[illegible]	3.1	2.4	[illegible]	[illegible]	[illegible]	332	[illegible]	2,413	1,366	1,096	844	475	2.41	2.26	[illegible]	7,862
260...	98	98	42.5	39.5	10.0	10.5	[illegible]	[illegible]	1.2	1.3	1,744	[illegible]	5	181	[illegible]	[illegible]	512	912	140	766	3.42	1.98	[illegible]	6,398
327...	98	......	39	......	19.0	...	5,312	.	2.3	...	[illegible]	..	177		[illegible]		1,044	..	1,044	..	1.50	...	[illegible]	...
314...	99	......	74	.....	20.0	....	[illegible]	.	2.5	..	[illegible]	.	185		[illegible]		724	.	130	.	2.04	.	[illegible]	.
265...	100	100	53.5	57	15.5	12.0	10,624	[illegible]	2.4	2.4	[illegible]	1,365	15	95	[illegible]	[illegible]	[illegible]	—1,050	—1,633	—1,050	4.58	3.73	[illegible]	6,618
238...	100	......	47.8	..	11.0	....	[illegible]	.	1.2	..	[illegible]	...	255	.	[illegible]		1,020	....	647	....	2.41	.	[illegible]	.
241...	100	100	50	47	12.0	11.5	8,039	7,846	2.2	3.0	1,517	1,655	195	324	[illegible]	[illegible]	67	—834	67	—834	2.36	3.22	[illegible]	8,125
251...	100	100	45.6	58	20.0	23.0	15,342	16,432	2.5	2.0	[illegible]	2,918	...	.....	[illegible]	[illegible]	—274	—919	—274	—919	2.14	2.54	[illegible]	6,627
299...	100	220	47.5	67	14.5	16.0	8,707	12,207	2.4	2.7	2,545	3,001	3,405	3,914	[illegible]	[illegible]	2,162	1,026	1,673	505	1.96	1.62	7,415	7,802
274...	100	100	40.2	42	16.5	17.0	15,739	15,661	2.6	2.8	1,597	2,116	95	57	1,770	2,151	[illegible]	—862	—90	—1,072	1.82	3.69	5,997	5,496
253...	100	100	36.8	33	10.5	11.0	9,198	9,754	2.0	2.0	1,673	1,320	155	19	1,244	1,787	175	—833	175	—833	1.72	3.27	7,788	6,164

287...	103	103	50.5	57	13.0	13.0	12,572	12,156	1.5	2.2	1,688	1,727	109	174	1,182	1,673	110	—97	110	—97	2.70	2.69	5,832	6,918
243...	104	175	45.2	50	42.5	42.0	23,800	29,128	2.7	2.6	3,833	3,365	......	.....	5,104	5,076	—62	—1,100	—62	—1,100	4.12	3.71	4,660	4,588
254...	104	......	50	......	27.0	....	14,219	....	2.3	...	4,330	......	640	.....	2,388	......	2,876	....	2,577	....	1.54	....	7,477	......
281...	106	106	57	60	13.5	16.0	11,158	11,200	2.2	2.1	1,878	1,527	106	1,147	2,115	3,084	—601	—976	—960	—1,133	2.77	4.04	5,773	4,635
255...	107	137	46.5	45	9.0	10.0	10,594	10,442	2.1	1.6	920	994	1,150	729	1,079	1,287	486	44	230	35	5.08	3.69	4,161	5,544
284...	110	110	37.5	39.5	13.5	15.0	8,283	8,290	2.2	1.9	1,480	1,203	320	120	1,556	2,024	—244	—703	—244	—703	2.65	3.93	5,378	4,230
228...	111	111	47	47.8	17.0	18.0	19,736	20,232	1.6	1.2	1,735	1,761	346	214	2,284	2,315	60	—122	60	—122	2.77	3.05	5,771	5,636
271...	111	111	44	48	16.0	15.0	12,687	12,813	1.8	1.9	2,023	1,747	888	938	1,571	1,853	938	715	938	715	2.08	2.71	6,881	6,661
262...	111	111	35.3	29	12.0	14.5	8,456	8,474	2.1	2.0	1,564	1,081	131	88	1,391	1,576	206	—13	206	—13	1.93	2.85	6,770	4,572
342...	114	114	72	79	23.5	26.5	21,413	21,568	2.5	2.6	3,440	4,446	1,935	1,760	2,770	3,127	1,631	2,038	1,595	1,581	2.24	2.18	7,245	7,161
301...	115	115	48	52	14.5	16.0	17,040	16,862	1.4	2.2	1,731	1,692	62	120	806	1,123	—129	—48	—418	—189	3.39	2.74	4,920	5,177
249...	115	115	39	42	19.0	17.5	17,067	16,286	1.5	1.2	3,057	2,388	344	344	1,930	1,681	944	304	944	127	1.90	2.49	8,085	6,093
252...	116	......	66.5	......	14.0	....	7,186	....	1.3	...	2,121	......	543	......	754	.....	1,639	....	1,474	..	2.08	....	7,188	......
242...	118	......	42.2	......	20.5	....	7,730	....	2.3	....	1,789	......	......	......	1,883	.....	—394	....	—729	...	4.29	....	3,517	......
325...	120	......	64	....	14.0	....	12,141	....	3.1	..	2,607	......	742	......	2,717	....	209	....	—273	..	2.90	....	7,695	......
321...	120	120	52.5	53	11.0	13.0	16,866	16,625	2.0	2.0	1,792	1,859	301	98	1,986	2,386	—625	—606	—957	—784	3.00	2.81	7,414	7,147
270...	120	120	40	47.5	14.0	12.5	13,388	13,590	2.0	1.6	2,318	2,250	15	35	2,198	1,618	38	436	—463	67	1.98	2.70	7,144	7,641
237...	122	122	63.2	82	12.0	11.0	11,140	11,478	1.2	2.0	661	1,193	1,140	970	1,991	1,723	—20	771	—20	787	5.54	2.85	3,998	6,166
337...	122	122	35.8	39	15.0	14.0	10,586	10,220	3.0	2.2	2,002	1,996	......	......	2,640	1,304	—592	—491	—983	—708	2.38	2.71	5,377	6,579
257...	124	124	49	49.5	11.0	12.5	10,480	10,347	1.8	1.7	1,005	1,147	402	117	1,586	1,370	—104	—478	—104	—478	4.63	3.21	5,805	5,166
240...	124	124	47.5	46	15.5	18.0	9,665	10,366	2.2	2.5	2,134	2,232	313	504	3,269	2,602	182	592	93	592	2.57	2.21	6,705	6,140
309...	125	125	50.5	52	8.0	9.0	11,766	11,762	1.1	1.1	1,422	1,334	276	655	935	718	677	1,025	677	1,025	1.99	2.26	9,417	7,721
319...	125	125	54	49.5	24.0	24.0	13,924	13,703	3.0	3.0	3,594	3,484	515	483	3,788	3,473	351	234	351	234	1.76	1.98	7,689	7,016
286...	127	127	45	52	25.0	25.5	18,170	18,671	2.5	2.5	2,343	3,139	206	160	3,549	2,591	—297	36	—297	3	2.65	2.55	5,052	6,255
326...	127	125	49.5	42	14.0	13.0	7,130	7,357	1.9	1.7	2,088	1,828	25	22	1,886	1,632	226	279	—159	90	2.66	2.51	6,332	6,274
279...	129	133	51.5	56.5	12.5	12.5	9,981	10,392	1.9	1.9	1,290	889	55	295	2,152	1,034	63	364	63	364	2.87	1.34	6,634	5,161
280...	130	130	56.5	57	21.5	19.0	17,600	17,426	1.2	2.4	2,636	2,929	880	441	1,889	2,079	786	2,088	786	2,088	2.75	1.33	6,631	7,902
344...	132	......	31.3	.....	12.5	....	13,760	.....	2.1	....	1,845	.....	......	......	2,763	....	—514	......	—532	......	2.46		6,734	...
224...	135	130	68	64	27.0	21.5	25,520	25,540	3.1	3.2	3,362	2,500	4,050	438	4,291	4,073	2,293	—2,315	2,293	—2,315	2.34	2.33	6,630	5,959
308...	135	135	57.5	59	15.0	15.5	13,042	13,072	3.3	2.3	2,269	2,578	547	922	4,088	2,598	—1,012	383	—1,012	383	2.55	2.60	8,154	8,934
340...	137	137	63	55.5	15.0	14.5	11,731	11,290	1.9	1.8	2,283	2,494	20	25	1,473	1,172	17	567	—393	312	2.55	1.69	6,490	7,584
263...	139	139	64	59	25.5	26.5	19,986	19,830	3.1	2.2	3,394	3,422	2,995	328	4,804	2,216	709	996	709	996	2.51	1.90	7,349	6,671
278...	140	140	58	56	20.0	21.0	22,514	24,262	2.6	2.7	2,996	2,594	40	325	5,010	5,178	—2,258	276	—2,258	276	3.94	1.66	8,284	6,219
261...	140	140	50	52	17.0	17.5	13,050	12,962	2.1	2.3	1,801	1,909	90	15	1,824	1,749	—487	—300	—487	—300	2.50	2.81	5,821	5,968
277...	141	141	81	73	17.0	16.0	17,640	17,492	2.5	1.5	2,999	1,540	680	35	2,242	1,835	819	—1,055	211	—1,055	2.64	3.79	6,746	4,648
275...	142	142	61	59	18.5	18.5	17,084	16,258	2.8	2.7	2,738	2,755	494	795	4,040	3,018	—1,337	—699	—1,365	—982	2.95	2.81	7,769	6,986
272...	142	150	73	80	22.0	23.0	19,690	20,988	2.7	1.4	2,561	4,251	10	......	2,127	4,531	—553	2,086	—553	1,591	2.35	3.24	6,253	7,729
329...	145	......	99.2	....	25.5	....	18,316	.....	2.5	..	4,556	....	493	....	3,478	....	2,367	....	1,466	.....	2.03	....	7,805	.
312...	145	145	48.5	61.5	28.0	18.0	20,925	18,970	3.2	2.1	5,252	3,646	460	835	4,229	2,516	1,536	1,674	482	1,289	1.90	1.69	7,738	9,196
328...	147	87	45	19.8	11.5	14.0	6,613	4,582	1.2	1.3	1,370	1,806	475	50	1,052	1,385	846	33	595	—153	3.35	2.65	4,896	5,490
259...	150	150	103	89	23.5	30.0	17,258	18,172	3.0	2.8	2,246	2,747	806	400	4,344	3,376	—1,287	424	—1,287	379	4.25	1.94	5,137	4,431
283...	150	150	52	69	12.5	13.0	17,166	17,132	2.2	1.6	1,806	1,695	467	595	2,105	1,561	—440	7	—440	7	2.56	2.77	6,943	6,209
227...	150	150	78.5	62	21.5	21.5	19,964	19,750	2.1	2.2	4,138	3,345	116	750	1,705	3,126	1,706	612	896	225	1.98	2.48	7,774	7,004
244...	152	130	20.8	55	13.5	11.5	11,730	7,825	2.0	1.6	1,330	1,029	......	.....	1,750	1,224	241	76	241	76	2.87	2.81	5,047	4,830
343...	156	154	60.5	56	14.5	19.0	13,735	13,828	1.5	2.0	2,197	2,413	788	786	1,544	2,442	1,295	178	1,271	—69	1.79	2.61	8,025	5,997
297...	157	.....	64.8	...	20.5	......	17,225	....	2.3	...	2,884	......	364	......	3,678	......	—270	......	—270	....	1.75	....	7,740	.....
290...	160	......	70	......	23.5	....	10,868	......	1.8	....	2,460	.....	685	......	1,744	.....	702	......	702	....	2.59	....	5,199	......
341...	160	.....	52	......	27.5	....	16,431	....	2.0	....	3,055	..	50	....	4,433	.....	—366	......	—366	......	2.50	..	5,971	......
289...	160	160	67	55.5	22.5	23.5	9,492	9,335	3.1	2.2	3,433	3,014	15	..	2,560	3,325	1,058	—318	349	—848	1.68	2.53	5,994	5,168
256...	161	161	71	66	29.0	27.0	15,646	16,148	3.0	3.2	4,533	5,453	627	303	4,545	3,588	1,427	1,476	1,383	674	1.97	1.58	8,941	8,855
230...	162	162	79	76.8	32.0	34.5	22,519	22,684	4.7	3.2	5,242	5,903	526	1,261	4,664	2,850	932	3,496	—67	2,864	2.59	1.73	6,786	7,448
288...	164	.....	66.5	......	23.5	....	18,594	....	2.8	...	2,600	.....	100	.....	3,487	......	—390	......	—541	......	2.43	....	5,624	......
318...	165	165	120	125	23.5	21.0	21,602	20,721	3.0	2.9	1,875	2,686	2,067	2,053	3,408	3,948	482	685	231	685	2.67	1.95	3,785	6,337
239...	170	170	74	91	29.0	27.5	19,018	19,064	3.2	3.0	3,983	4,159	290	551	4,672	4,759	—568	870	—614	436	2.38	1.99	7,153	6,855

TABLE 78 (*concluded*)

Farm no.	Acres operated 1921	Acres operated 1922	Acres of crops 1921	Acres of crops 1922	Number of cows 1921	Number of cows 1922	Average total capital 1921	Average total capital 1922	Man equivalent 1921	Man equivalent 1922	Milk sales 1921	Milk sales 1922	Crop sales 1921	Crop sales 1922	Current farm expenses 1921	Current farm expenses 1922	Labor income 1921	Labor income 1922	Labor income on pool-price basis 1921	Labor income on pool-price basis 1922	Cow cost of milk per cwt. 1921	Cow cost of milk per cwt. 1922	Pounds of milk produced per cow 1921	Pounds of milk produced per cow 1922
316...	178	178	75	75.5	21.0	22.5	18,748	18,342	3.6	2.0	2,526	2,434	250	....	3,576	2,377	—1,456	—555	—1,456	—555	2.48	2.17	6,119	5,234
273...	178	178	84.2	85	27.5	23.0	20,206	19,978	3.2	3.0	4,270	4,106	526	320	4,081	4,478	—239	—309	—239	—451	1.98	2.61	7,817	8,514
336...	180	180	126	108	25.5	26.0	24,928	25,347	3.0	3.0	3,375	2,505	2,240	976	4,419	2,921	633	—409	491	—409	2.42	2.93	6,782	4,828
276...	180	180	75	74	22.5	23.5	25,326	24,183	2.2	2.2	3,623	3,171	816	367	2,815	3,035	392	—992	392	—1,024	1.72	2.08	8,887	6,717
332...	187	187	74	74	34.0	30.5	19,956	19,146	3.0	3.1	3,258	3,091	. .	360	5,726	5,168	—1,974	—2,029	—1,974	—2,360	3.17	3.38	5,140	4,960
250...	192	197	89	88	16.5	18.5	11,688	12,170	2.6	2.2	2,576	2,960	709	925	3,981	2,641	—87	790	—579	490	3.00	2.42	7,318	7,674
317...	192	192	86	97	20.0	22.5	18,372	18,654	2.0	2.4	2,710	3,168	704	1,264	2,731	3,439	—236	732	—742	208	2.96	2.62	5,714	5,848
291...	199	199	69.5	67.5	25.0	21.0	20,155	22,107	3.1	2.8	3,913	2,892	379	797	9,340	4,627	—549	—234	—584	—462	1.97	2.93	7,895	6,188
306...	200	200	80.5	82	14.0	17.5	22,415	21,848	3.4	2.2	1,530	2,033	4,106	1,768	5,908	3,629	—308	—1,730	—308	—1,730	3.37	3.84	5,857	6,012
245...	200	200	152	129	26.5	24.0	26,526	25,574	5.1	3.2	3,404	5,127	3,029	1,826	7,109	5,220	—1,946	602	—2,349	20	3.00	1.62	5,988	10,516
282...	200	220	88	107	24.0	24.0	12,724	11,402	2.6	3.2	3,026	2,769	1,078	697	4,712	3,770	—1,549	—946	—2,115	—1,244	2.98	2.80	5,466	5,512
226...	200	200	79	79	30.0	30.0	29,844	29,942	3.0	4.0	3,403	3,760	1,090	2,675	3,069	7,235	12	—1,129	12	—1,129	2.85	2.27	5,605	6,374
293...	200	200	39.5	41.5	15.0	15.5	20,996	13,310	2.5	2.2	2,081	2,532	198	68	1,718	1,551	—56	629	—56	629	2.30	1.55	7,416	8,410
258...	210	210	82.5	57	23.5	24.5	17,238	17,860	2.0	2.2	3,283	2,973		69	2,985	2,666	675	378	675	89	2.43	2.33	7,870	5,365
229...	212	212	102	98	47.3	33.5	23,665	20,037	3.3	3.0	3,822	3,340	50	125	3,835	3,798	—1,088	—1,452	—1,498	—1,452	4.64	3.37	3,659	5,000
333...	213	213	46.5	49	17.0	17.5	15,464	15,362	2.1	2.5	1,920	2,302	.	..	1,363	2,111	—165	27	—183	—203	2.87	3.14	5,618	5,705
284...	218	218	102.5	90.5	39.5	35.0	25,092	24,532	3.4	2.9	3,919	4,575	570	721	3,027	3,630	—350	972	—350	972	2.50	1.43	5,023	6,244
331...	230	230	124.5	117	20.5	19.0	17,688	17,565	3.7	4.1	3,158	2,472	1,468	1,225	3,797	5,546	474	—2,095	—107	—2,351	2.66	3.27	6,236	5,638
223...	238	238	79	73	50.0	48.0	30,525	30,696	8.0	5.2	5,983	5,748	7,895	1,243	10,697	8,061	1,436	—3,342	1,436	—3,342	2.20	2.29	5,793	6,017
292...	240	240	156.2	163	26.5	28.5	32,059	30,440	4.2	4.0	3,234	4,116	1,150	881	4,908	4,330	—1,739	1,716	—1,790	1,024	3.72	3.03	6,200	6,353
334...	245	202	177.5	123	19.5	23.0	29,373	26,702	7.0	4.4	3,188	2,571	19,634	4,230	17,588	7,581	4,748	—1,875	4,134	—2,136	3.11	4.28	6,842	5,031
303...	250	250	120	105	44.5	47.0	26,692	27,305	4.6	5.0	8,125	5,267	1,083	75	8,778	7,724	2,335	—2,047	2,348	—2,047	1.97	2.50	9,160	5,817
305...	250	250	80.5	87.5	34.5	29.7	24,880	24,494	2.7	2.4	4,715	4,167	494	553	3,405	2,665	1,672	963	1,672	963	1.37	2.09	7,004	7,300
225...	283	283	102	100	40.0	37.5	37,018	36,755	4.9	3.3	4,374	4,286	2,076	1,370	8,211	4,096	—1,209	868	—1,793	512	2.37	1.97	4,808	5,426
222...	300	......	57.5	......	18.5	....	22,304	....	2.1	...	2,786	. .	1,930	.....	4,506	......	1,466	......	823	....	2.48	...	6,325	. .
335...	357	226	136	121	28.0	28.5	35,692	15,532	4.2	3.2	5,152	4,477	3,142	1,942	5,784	4,398	2,188	1,741	1,206	1,289	1.87	2.54	7,463	6,841
267...	360	360	111	90	29.0	31.5	19,179	18,164	4.0	3.8	2,679	3,067	638	725	4,334	3,631	—1,760	—672	—1,760	—672	3.83	2.64	4,723	5,107
324...	393	393	150	158	32.5	37.5	28,773	30,505	2.3	2.8	3,659	3,[illegible]65	1,039	525	5,633	3,997	279	—552	—402	—972	3.22	3.20	4,930	4,830
266...	450	450	337	124	20.5	23.0	29,534	29,707	4.0	1.7	2,253	1,577	2,445	324	5,901	2,564	—1,557	—2,215	—1,826	—2,481	4.30	3.58	5,175	3,166

TABLE 79. COST OF PRODUCING MILK, PRICES RECEIVED, AND LABOR INCOMES, ON DAIRY FARMS IN AN ALFALFA REGION FOR THE CROP YEARS OF 1921 AND 1922, ARRANGED ACCORDING TO COST OF MILK IN 1921

Farm no.	Cost of milk per 100 pounds		Labor income		Labor incomes on pool-price basis		Pounds of milk produced per cow		Average price received for milk, certificate of indebtedness plus cash		Crop sales	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
305	$1.37	$2.09	$1,672	$ 963	$1,672	$ 963	7,004	7,300	$2.04	$2.02	$ 494	$ 553
254	1 54	......	2,876	......	2,577	.....	7,477	......	2.18	......	640	......
295	1.63	2.24	81	825	81	762	10,358	9,160	1.99	2.12	98	940
310	1.65	2.63	495	79	495	79	9,795	8,712	2.03	2.05	132	......
247	1.67	3.76	783	-26	767	-244	8,865	7,905	2.10	2.43	76	56
289	1.68	2.53	1,058	-318	-349	-848	5,994	5,168	2.59	2.55	15	......
276	1.72	2.08	392	-992	392	-1,024	8,887	6,717	1.85	2.09	816	367
253	1.72	3.27	175	-833	-175	-833	7,788	6,164	2.10	2.13	155	10
339	1.74	2 99	426	-1,051	426	-1,051	7,737	7,029	2.06	2.08	3	185
297	1.75	......	-270	......	-270	......	7,740	......	1.97	......	364	......
322	1.75	2.31	897	881	602	729	6,524	5,812	2.62	2.39	301	1,070
319	1.76	1.98	351	234	351	234	7,689	7,016	1.96	2.09	515	483
343	1.79	2.61	1,295	178	1,271	-69	8,025	5,997	2.10	2 38	788	786
327	1.80	......	1,044	......	1,044	.....	8,427	......	2.00	......	177	......
300	1.80	1.95	-259	-587	-259	-587	7,435	6,907	1.98	2.15	98	.....
274	1.82	3.69	-68	-862	-90	-1,072	5,607	5,496	2.01	2.37	98	57
231	1.83	2.91	583	497	583	497	5,950	6,109	2.13	2.06	125	181
335	1.87	2.54	2,188	1,741	1,206	1,289	7,463	6,841	2.52	2.33	3,142	1,942
312	1.90	1.69	1,536	1,674	482	1,289	7,738	9,196	2.58	2.37	460	835
249	1.90	2.49	944	304	944	127	8,085	6,093	2.02	2.30	344	344
262	1 93	2.85	206	-13	206	-13	6,770	4,572	2 04	1.82	131	88
236	1.93	2.05	494	370	494	349	6,698	7,741	2.05	2.03	110	......
246	1.96	2.23	-158	-141	-410	-141	10,393	8,327	2 10	2.06	387	484
299	1.96	1.62	2,162	1,026	1,673	508	7,445	7,802	2.44	2.47	3,405	3,914
291	1.97	2.93	-549	-234	-584	-462	7,895	6,188	2.06	2.30	379	797
256	1.97	1.58	1,427	1,476	1,383	674	8,941	8,855	1.93	2.38	627	303
303	1.97	2.50	2,335	-2,047	2,348	-2,047	9,160	5,817	2.02	1.99	1,083	75
273	1.98	2.61	-239	-309	-239	-451	7,817	8,514	2.03	2.22	526	320

TABLE 79 (*continued*)

Farm no.	Cost of milk per 100 pounds		Labor income		Labor incomes on pool-price basis		Pounds of milk produced per cow		Average price received for milk, certificate of indebtedness plus cash		Crop sales	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
270	1.98	2.70	38	436	-463	-67	7,144	7,641	2.54	2.48	15	35
227	1.98	2.48	1,706	612	896	225	7,774	7,004	2.55	2.28	116	750
309	1.99	2.26	677	1,025	677	1,025	9,417	7,721	2.02	2.13	276	655
302	2.01	......	914	......	1,059	......	10,740	......	1.92	......	44	......
329	2.03	......	2,367	......	1,466	......	7,805	......	2.48	......	493	......
314	2.04	......	724	......	130	......	6,605	......	2.53	......	185	......
271	2.08	2.71	938	715	938	715	6,881	6,661	1.93	1.85	888	938
252	2.08	......	1,639	......	1,474	......	7,188	......	2.20	......	543	......
315	2.11	2.76	55	-786	55	-786	6,601	5,722	2.08	2.12	501	938
269	2.12	1.76	96	-444	82	-641	7,669	5,694	2.07	2.34	310	244
251	2.14	2.54	-274	-919	-274	-919	8,972	6,627	2.01	2.00	......	......
233	2.14	2.01	1,279	1,147	553	829	6,642	6,537	2.70	2.35	......	106
234	2.18	2.33	69	207	69	207	8,187	6,831	1.96	2.03	12	156
223	2.20	2.29	1,436	-3,342	1,436	-3,342	5,793	6,017	2.10	2.09	7,895	1,243
342	2.24	2.18	1,631	2,038	1,595	1,581	7,245	7,161	2.10	2.41	1,935	1,760
221	2.27	3.64	684	250	684	250	7,553	5,601	1.89	1.94	......	202
293	2.30	1.55	-56	629	-56	629	7,416	8,410	2.03	2.02	198	68
224	2.34	2.33	2,293	-2,315	2,293	-2,315	6,630	5,959	1.97	2.06	4,050	438
272	2.35	3.24	-553	2,086	-553	1,591	6,253	7,729	1.99	2.47	10	......
241	2.36	3.22	67	-834	67	-834	7,814	8,125	2.04	1.90	195	324
225	2.37	1.97	-1,209	868	-1,793	512	4,808	5,426	2.36	2.18	2,076	1,370
337	2.38	2.71	-592	-491	-983	-708	5,377	6,579	2.56	2.25	......	......
239	2.38	1.99	-568	870	-614	436	7,153	6,855	2.07	2.36	290	551
338	2.41	3.68	83	407	71	256	7,040	6,259	2.01	2.39	90	365
220	2.41	2.26	1,366	1,096	844	475	7,096	7,862	2.57	2.67	136	339
238	2.41	......	1,020	......	647	......	6,697	......	2.61	......	256	......
336	2.42	2.93	633	-409	491	-409	6,782	4,828	2.12	2.05	2,240	976
258	2.43	2.33	675	378	675	89	7,870	5,365	1.98	2.35	......	69
288	2.43	......	-390	......	-541	......	5,624	......	2.04	......	100	......

323	2.44	2.15	299	181	-78	13	8,644	6,667	2.50	2.38	......	134
285	2.44	2.36	-558	426	-645	176	8,730	8,795	2.20	2.43	......	222
313	2.45	......	-413	......	-413	......	7,493	......	2.06	......	10	......
344	2.46	......	-514	......	-532	......	6,734	......	2.27	......	......	......
316	2.48	2.17	-1,456	-555	-1,456	-555	6,119	5,234	2.10	2.12	250	......
222	2.48	......	1,466	......	823	......	6,325	......	2.56	......	1,930	......
341	2.50	......	-366	......	-366	......	5,971	......	2.02	......	50	......
261	2.50	2.81	-487	-300	-487	-300	5,821	5,968	1.89	1.91	90	15
264	2.50	1.43	-350	972	-350	972	5,023	6,244	2.00	2.19	570	721
263	2.51	1.90	709	996	709	996	7,349	6,671	1.94	2.04	2,995	328
340	2.55	1.69	17	567	-393	312	6,490	7,584	2.41	2.34	20	25
307	2.55	......	481	......	130	......	6,709	......	2.92	......	150	......
308	2.55	2.60	-1,012	383	-1,012	383	8,154	8,934	2.01	2.07	547	922
283	2.56	2.77	-440	7	-440	7	6,943	6,209	2.16	2.17	467	595
240	2.57	2.21	182	592	93	592	6,705	6,140	2.13	2.11	313	504
290	2.59	......	702	......	702	......	5,199	......	2.03	......	685	......
268	2.59	2.31	24	-871	24	-871	5,687	4,887	2.15	1.98	927	303
230	2.59	1.73	932	3,496	-67	2,864	6,786	7,448	2.47	2.33	526	1,261
277	2.64	3.79	819	-1,055	211	-1,055	6,746	4,648	2.71	2.17	680	35
284	2.65	3.93	-244	-703	-244	-703	5,378	4,230	2.14	1.99	320	120
286	2.65	2.55	-297	36	-297	3	5,052	6,255	2.00	2.07	206	160
331	2.66	3.27	474	-2,095	-107	-2,351	6,236	5,638	2.56	2.37	1,468	1,225
326	2.66	2.51	226	279	-159	90	6,332	6,274	2.47	2.31	25	22
318	2.67	1.95	482	685	231	685	3,785	6,337	2.21	2.10	2,067	2,053
287	2.70	2.69	110	-97	110	-97	5,832	6,918	2.30	2.04	109	174
235	2.72	3.90	113	-503	113	-503	6,525	5,187	2.01	2.16	146	344
330	2.73	3.21	685	217	372	80	5,415	5,298	2.54	2.11	376	386
280	2.75	1.33	786	2,088	786	2,088	6,631	7,902	1.94	2.07	880	441
281	2.77	4.04	-601	-976	-960	-1,133	5,773	4,635	2.64	2.33	106	1,147
228	2.77	3.05	60	-122	60	-122	5,771	5,636	1.93	1.95	346	214
298	2.79	4.79	288	-1,455	103	-1,485	6,404	6,076	2.29	2.05	962	848
226	2.85	2.27	12	-1,129	12	-1,129	5,605	6,374	2.06	2.06	1,090	2,675
333	2.87	3.14	-165	27	-183	-203	5,618	5,705	2.11	2.44	......	......
279	2.87	1.34	63	364	63	364	6,634	5,161	1.86	1.77	55	295
244	2.87	2.81	241	76	241	76	5,047	4,830	2.03	2.01	......	......
325	2.90	......	209	......	-273	......	7,695	......	2.52	......	742	......
275	2.95	2.81	-1,337	-699	-1,365	-982	7,769	6,986	2.01	2.34	494	795
317	2.96	2.62	-236	732	-742	208	5,714	5,848	2.50	2.45	704	1,264
282	2.98	2.80	-1,549	-946	-2,115	-1,244	5,466	5,512	2.38	2.22	1,078	697
232	2.98	2.74	-22	415	-22	415	9,117	11,397	2.15	2.09	80	62

TABLE 79 (*concluded*)

Farm no.	Cost of milk per 100 pounds		Labor income		Labor incomes on pool-price basis		Pounds of milk produced per cow		Average price received for milk, certificate of indebtedness plus cash		Crop sales	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
245	3.00	1.62	−1,946	602	−2,349	20	5,988	10,516	2.22	2.10	3,029	1,826
321	3.00	2.81	−625	−606	−957	−784	7,414	7,147	2.48	2.41	301	98
250	3.00	2.42	−87	790	−579	490	7,318	7,674	2.45	2.29	709	925
296	3.10	2.67	1,902	666	1,396	617	5,374	6,959	2.94	2.14	1,815	485
334	3.11	4.28	4,748	−1,875	4,134	−2,136	6,842	5,031	2.61	2.39	19,634	4,230
294	3.11	3.55	−531	−94	−782	−257	7,449	7,993	2.44	2.39	60	120
311	3.16	4.93	856	83	856	83	6,574	6,033	1 94	1.90	820	365
332	3.17	3.38	−1,974	−2,029	−1,974	−2,360	5,140	4,960	1.95	2.19	......	360
248	3.21	2.55	−1,150	703	−1,150	703	5,225	5,455	1.97	2.11	......	95
324	3.22	3.20	279	−552	−402	−972	4,930	4,830	2.56	2.34	1,039	525
328	3.35	2.65	846	33	595	−153	4,896	5,490	2.63	2.42	475	50
306	3.37	3 84	−308	−1,730	−308	−1,730	5,857	6,012	2.09	2.19	4,106	1,768
301	3.39	2.74	−129	−48	−418	−189	4,920	5,177	2.66	2.41	62	120
260	3.42	1.98	512	912	140	766	7,064	6,398	2.57	2.36	3	181
304	3.49	2.58	70	−148	70	−148	6,428	6,434	1.99	1.85	137	103
320	3.68	2.98	−430	313	−710	156	5,328	5,725	2.49	2.47	290	305
292	3 72	3.03	−1,739	1,716	−1,790	1,024	6,200	6,353	2.02	2.45	1,150	881
267	3.83	2.64	−1,760	−672	−1,760	−672	4,723	5,107	2 10	2.10	638	725
278	3.94	1.66	−2,258	276	−2,258	276	8,284	6,219	1 94	2.19	40	325
243	4.12	3.71	−62	−1,100	−62	−1,100	4,660	4,588	1.99	1.99	......	......
259	4.25	1.94	−1,287	424	−1,287	379	5,137	4,431	1 93	2.15	806	400
242	4.29	......	−394	......	−729	......	3,517	......	2.56	......	......	......
266	4.30	3.58	−1,557	−2,215	−1,826	−2,481	5,175	3,166	2.33	2.32	2,445	324
265	4.58	3.73	−1,633	−1,050	−1,633	−1,050	5,186	6,618	1.93	2.03	16	95
257	4.63	3.21	−104	−478	−104	−478	5,805	5,166	1.84	1.91	402	117
229	4.64	3.37	−1,088	−1,452	−1,498	−1,452	3,659	5,000	2.32	2.12	50	125
255	5.08	3.69	486	44	230	35	4,161	5,544	2.91	2.04	1,150	729
237	5.54	2.85	−20	771	−20	787	3,998	6,166	1.73	2.05	1,140	970

SUMMARY

The averages of the most important factors in the dairy enterprise for each year are given in table 80. A comparison of the data for the two years, of factors that would be expected to be the same each year, testifies to the accuracy of the survey method of enumeration, as different men did the enumerating each year. Such a comparison indicates also the stability of the system of farming, for very few changes in organization and practices were made.

TABLE 80. AVERAGES FOR TWO YEARS

	125 farms in 1921	108 farms in 1922
Year of record ending, April 30	1922	1923
County	Madison	Madison
Labor income	+$228	+$4
Labor income on pool-price basis	+$44	−$143
Size of business:		
1. Productive man-work units	607	618
2. Acres of crops	63 0	62.7
3. Acres pastured (woods in equivalent of open pasture)	56.0	61.4
4. Number of cows, average	19	19
5. Number of men, including operator	2.47	2 31
6. Capital	$15,371	$15,588
7. Hundredweight of milk sold per farm	1,187	1,145
8. Animal units per farm:		
Including work animals	28.7	28 9
Excluding work animals	24 8	25.0
Type of business:		
9. Average miles to milk station	2.4	3.0
10. Per cent of total productive man-work units on:		
Cattle	57.8	60.5
Cultivated crops	17.5	16 6
Grain crops, annual hay crops, and peas	4 3	3.9
Hay, including alfalfa cured and green	17.1	15.7
All else	3.3	3.3
11. Total productive man-work units on farm per acre of crops	9 6	9 9
12. Per cent of capital in.		
Real estate	72	73
Livestock	20	19
Equipment and supplies	8	8
13. Per cent of cows freshening from September to December inclusive	45 4	49 5
14. Per cent of milk sold during:		
May, June, July	27.1	29.8
August, September, October	19 9	20.2
November, December, January	25.2	24.0
February, March, April	27 8	26.0
15. Average weight of cows (pounds)	979	977
16. Average weeks cows are dry	7.1	7.5
17. Per cent of cows less than four years old	30 4	29 0
18. Per cent of cows replaced	18 6	23.8
19. Per cent of cows added that were raised at home	65.5	65.8
20. Per cent of cows added that were purchased	34 5	34 2
21. Average age of heifers when freshening for first time (months)	27.1	27.2
22. Grade of milk	Grade B	Grade B
23. Per cent of milk produced which is sold	94.7	94.5
24. Per cent of milk kept at farm	5 3	5.5

TABLE 80 (*continued*)

	125 farms in 1921	108 farms in 1922
Year of record ending April 30	1922	1923
County	Madison	Madison
Balance of business:		
25. Pasture acres per animal unit pastured	2.4	2.6
26. Acres of crops per animal unit	2.2	2.2
27. Manure per acre of crops (tons)	3.6	3.4
28. Manure applied per acre of crops receiving manure (tons)	13.2	13.0
29. Value of purchased fertilizer per acre of crops	$0.75	$0.66
30. Labor distribution (good, fair, poor)	Fair	Fair
31. Important sources of income, and receipts from each per farm:		
Milk	$2,586	$2,515
Appreciation on cattle	$302	$250
Crops sold	$801	$551
32. Elements removed per acre by crops (pounds):		
Nitrogen	84	80
Phosphoric acid	24	22
Potash	85	82
Lime (CaO)	61	64
33. Elements added per acre (pounds):		
Nitrogen	110	108
Phosphoric acid	20	19
Potash	43	42
Lime (CaO)	35	37
34. Per cent of receipts from crops	18.7	14.9
Rates of production:		
35. Crop index, all crops (based on average yields for New York State)	100	98
36. Crop index:		
Corn for silo	192.4	155.0
Oats (threshed)	98.1	85.1
Alfalfa hay	79.5	85.7
Other hay	80.2	107.4
37. Pounds of milk produced per cow	6,592	6,330
38. Pounds of milk sold per cow	6,245	5,985
39. Pounds of milk produced per dollar invested in cows	65	62
40. Value of milk and its products sold per cow	$136	$132
41. Appreciation on cattle per cattle unit	$12.78	$10.46
Labor efficiency:		
42. Productive man-work units per man	246	268
43. Acres of crops per man	25.5	27.1
44. Animal units per man, except work animals	10.0	10.8
45. Productive horse-work units per work animal	68	67
46. Acres of crops per work animal	16.3	16.2
47. Labor returns per man	$503	$403
48. Labor returns per man-work unit	$2.05	$1.51
49. Per cent of farms using milking machines	46	....
50. Per cent of months machines are used	78	....
51. Hundredweight of milk produced per man	507	524
Human labor:		
Hours per cow per year:		
52. Milking	72	75
53. Hauling milk	25	21
54. Other labor	75	83
Hours per 100 pounds of milk produced:		
55. Pasture season	2.0	1.8
56. Winter	3.0	3.6
57. For year	2.6	2.8

TABLE 80 (*continued*)

	125 farms in 1921	108 farms in 1922
Year of record ending, April 30	1922	1923
County	Madison	Madison
Capital efficiency:		
58. Value of crop land per acre	$60.65	....
59. Value of pasture land per acre	$32.12	....
60. Value of woodland per acre	$34.51	....
61. Value of houses per farm	$1,973	....
62. Value of cattle barns per farm	$1,862	....
63. Value of other buildings per farm	$1,018	....
64. Per cent of real-estate capital in buildings	43.7	....
65. Per cent of real-estate capital in land	56.3	....
66. Value of machinery and equipment per acre of crops	$19.10	$19.38
Feeding efficiency:		
Feed:		
Per cow per year:		
67. Concentrates (pounds)	1,561	1,346
68. Silage (pounds)	8,127	7,371
69. Other succulent feed (pounds)	1,609	1,155
70. Dry forage (pounds)	5,009	4,950
71. Protein (digestible pounds)	849	799
72. Energy (therms)	4,114	3,760
73. Days of pasture per cow	157	160
Per cow per day during winter:		
74. Concentrates (pounds)	6.9	6.2
75. Silage (pounds)	36.9	34.5
76. Other succulent feed (pounds)	0.5	1.1
77. Dry forage (pounds)	23.1	23.2
78. Protein (digestible pounds)	3.7	3.6
79. Energy (therms)	17.9	17.0
80. Protein-energy ratio	1:4.9	1:4.7
Per 100 pounds of milk produced in pasture period:		
81. Concentrates (pounds)	4.7	2.9
82. Silage and other succulent feed (pounds)	74.9	44.7
83. Dry forage (pounds)	7.9	7.0
84. Days of pasture per 100 pounds of milk	6.0	5.9
Per 100 pounds of milk produced in winter period:		
85. Concentrates (pounds)	36.1	35.0
86. Silage (pounds)	192.5	195.5
87. Other succulent feed (pounds)	2.6	6.5
88. Dry forage (pounds)	120.4	131.4
89. Protein (digestible pounds)	19.1	20.3
90. Energy (therms)	93.1	96.3
Per 100 pounds of milk produced thru the year:		
91. Concentrates (pounds)	23.7	21.3
92. Silage (pounds)	123.3	116.5
93. Other succulent feed (pounds)	24.4	18.2
94. Dry forage (pounds)	76.0	78.2
95. Protein (digestible pounds)	12.9	12.6
96. Energy (therms)	62.4	59.4
Costs and returns for cows:		
97. Total costs per cow	$182.00	$176.00
98. Returns, exclusive of milk sold wholesale	$26.00	$24.00
99. Cost of milk sold wholesale per cow	$156.00	$152.00
100. Value of milk sold wholesale, cash per cow	$129.00	$127.00
101. Certificates of indebtedness, per cow	$7.00	$4.00
102. Gain or loss per cow (Loss)	$20.00	$21.00
103. Price received per 100 pounds of milk	$2.18	$2.19

TABLE 80 (*concluded*)

	125 farms in 1921	108 farms in 1921
Year of record ending, April 30	1922	1923
County	Madison	Madison
Costs and returns for cows (*continued*)		
104. Cost of producing 100 pounds of milk	$2.50	$2.54
105. Loss per 100 pounds of milk	$0.32	$0.35
Cost of raising a heifer:		
106. Till two years of age	$111	$93
107. Till freshening at 27 months (approximate)	$125	$105

Preceding publications on dairy farming by the same author, from the New York State College of Agriculture, are:

Calculating the cost of milk production. Reading-Course Lesson for the Farm, No. 142. 1919.

An economic study of dairying on 149 farms in Broome County, New York. Cornell Univ. Agr. Exp. Sta., Bulletin 409. 1922.

Relation of the composition of rations on some New York dairy farms to the economics of milk production. Cornell Univ. Agr. Exp. Sta., Memoir 64. 1923.

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An economic study of dairying on 163 farms in Herkimer County, New York. Cornell Univ. Agr. Exp. Sta., Bulletin 432. 1924.

Economic studies of dairy farming in New York. II. Grade A milk with and without cash crops. Cornell Univ. Agr. Exp. Sta., Bulletin 433. 1924.

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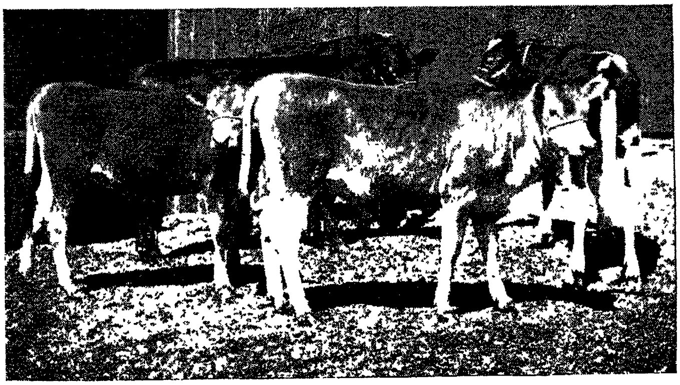
Rearing Calves by the Use of Calf-Meal Gruel

L. A. Maynard, L. C. Norris, and W. E. Krauss



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REARING CALVES BY THE USE OF CALF-MEAL GRUEL

L. A. MAYNARD, L. C. NORRIS, AND W. E. KRAUSS[1]

Rearing heifer calves from the better cows in the dairy herd is the ideal method of making replacements. The dairyman who replenishes his herd thru purchase loses the opportunity for herd improvement by breeding and selection, and also finds it more difficult to keep his herd free from disease; yet, as a general rule, it does not pay to rear calves unless it can be done cheaply and by a method which will induce a regular and rapid growth, for good cows cannot be expected to develop from undernourished calves.

The dairyman who has plenty of skimmilk can rear good calves cheaply. Where skimmilk is not available, however, the rearing of calves is a more difficult problem. The use of whole milk is too expensive a method except for animals that are very valuable because of their superior breeding. Of course the dairyman who sells his product as market milk can separate enough of it to provide skimmilk for his calves, but this necessitates extra equipment and labor and a suitable market for the cream.

This question of how to rear calves economically and satisfactorily when skimmilk is not available is a widely investigated subject. The use of powdered skimmilk has proved satisfactory, but up to the present time there has been little powdered skimmilk on the market at a price that would justify its use.

Many studies have been made of the minimum amount of whole milk required to rear calves satisfactorily, and it has been shown that a fair growth may be obtained by feeding the milk for two or three months only, and relying on grain and hay thereafter. Another method of rearing calves, which has received a large amount of study and is considerably used, is the substitution for milk, after the first few weeks, of a special grain mixture, generally called a calf meal, which is fed as a gruel. The studies reported in this bulletin are concerned with this latter method.

EXPERIMENTAL STUDIES

The formulation of a satisfactory mixture which can be fed as a gruel as a partial or complete substitute for milk is a problem which has received considerable attention both in America and in other dairy countries. A study of the problem was first carried on at this station from 1907 to 1909, and the results were published by Savage and Tailby (1909, 1911). The work described by these authors included studies of various proprietary calf meals and of dried milk products.

In 1916 the problem was taken up by the senior author of this bulletin. At that time a number of proprietary calf meals, as well as certain home-mixed preparations, were being considerably used in New York State. However, none of them proved satisfactory, and studies were therefore begun to assemble further data on the possibilities and limitations of the calf-meal method.

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[1] F. H. Peabody aided in the feeding and management of the animals used in the experiment.

In the early studies various formulas were tested with laboratory animals, as well as with calves, in an endeavor to formulate a calf meal which would have all the dietary essentials for growth and would be as suitable as possible to the digestive system of the young calf. At the same time studies were made of the digestive disorders of the calf in order to find what relation the character of the feed bore to them.

Special attention was directed to the young calf during the early weeks of its life, when the digestive troubles, as indicated by scouring, were generally more frequent if a calf meal was fed. It was appreciated that this change in the character of the feed from whole milk to calf meal, must involve a change in the bacterial flora of the intestinal tract, which might in turn be a factor in these digestive disturbances. Therefore an attempt was made to find whether excessive putrefaction was a factor in these troubles. In a preliminary trial, the results of which were published by Maynard and Norris (1922), evidence was obtained which indicated that excessive putrefaction was neither a cause nor an accompaniment of the troubles in question. Confirmatory evidence of this conclusion was found in a later trial, the results of which have not been published.

The question of fermentation was next considered. It was found that calves during the period of change from milk to gruel, and for a time at least thereafter when on gruel alone, excreted a much larger amount of acetic and propionic acids and of ethyl alcohol than did a calf that received milk only. These results, with certain other observations, were interpreted to indicate that an abnormal amount of fermentation was going on in the digestive tract of the calves fed the calf meal, due presumably to inability to digest the carbohydrates properly, and that this excessive fermentation was a factor in the increased digestive troubles occurring with the ration of calf meal. The results of this study have been reported by Norris (1925).

As a consequence of these studies of the digestive troubles, which furnished helpful information as to the physiological limitations of the calf-meal method, and as an outcome of trials with various other formulas, the results of which need not be detailed, a formula and method of feeding was arrived at which gave markedly better results than any previously tried here or reported elsewhere. The data presented in this bulletin include the results obtained with this formula, and a discussion of their practical application.

The calf-meal formula

The mixture adopted as a result of the earlier studies was as follows:

250 pounds yellow cornmeal
250 pounds red dog flour
150 pounds ground oat groats
150 pounds linseed oilmeal
100 pounds ground malted barley
100 pounds soluble blood flour
10 pounds calcium carbonate
10 pounds precipitated bone meal
10 pounds salt

This formula was found to have the following analysis: water, 9.3 per cent; ash, 5.1 per cent; protein, 24.0 per cent; crude fiber, 3.5 per cent; nitrogen-free extract, 53.7 per cent; fat, 4.4 per cent. This formula was mixed by hand in trials 1 and 2.

On the basis of the results of trials 1 and 2, this formula was adopted by the Cooperative Grange League Federation Exchange at Ithaca, New York, and was put out under the name of G. L. F. Calf Meal. This commercially mixed product was used in trial 3. For commercial mixing, the formula was changed slightly but not materially, as shown by the following published formula for G. L. F. calf meal, expressed on a ton basis:

500 pounds yellow cornmeal
440 pounds red dog flour
300 pounds oat flour
300 pounds linseed oilmeal
200 pounds malted barley
200 pounds soluble blood flour
20 pounds calcium carbonate
20 pounds steamed bone meal
20 pounds salt

These formulas are not to be considered as "milk substitutes," as calf meals have been loosely termed. They constitute a combination of ingredients which, when fed as a gruel, represents as suitable a feed to replace milk as the writers have been able to devise on the basis of their studies to date, with the limitation of the selection to those ingredients which are not too costly to use.

All of the ingredients have been selected to make the mixture very low in fiber, and to provide a gruel which in other respects will be as digestible as possible, inasmuch as the principal drawbacks to the use of a calf meal are its unsuitability to the digestive system of the young calf and the troubles that result therefrom. Each ingredient is finely ground, both because of its presumably higher digestibility thereby and because fineness of division is essential to avoid too rapid settling when the mixture is made into a gruel.

The blood flour furnishes a highly digestible animal protein to supplement the less efficient vegetable protein of the other ingredients. Blood flour has long been considered a valuable ingredient in calf meals, because of its nutritive value and also its favorable effect in counteracting digestive troubles. The product used was entirely soluble in water, and was obtained from the United Chemical and Organic Products Company, of Chicago, Illinois. It has proved superior to coarser and less soluble products which settle rapidly.

Linseed oilmeal is another favorite ingredient of calf meals, because of both its nutritive value and its beneficial physical effect. It also aids materially in keeping the meal in suspension in water by reason of its emulsifying properties.

Malted barley has a special value in that some of its starch has been partly digested and in that it contains large amounts of the enzyme diastase. The favorable effect of hydrolyzing starch in feeding it to

young calves has been shown by several investigators, for example by Hanne (1907). The usefulness of malted barley as an ingredient of a calf meal is also indicated by the results of the studies of fermentation referred to on page 4.

It is obvious that a cereal grain mixture is deficient in lime as compared to milk. In earlier studies, calcium carbonate alone was used to furnish an additional supply of this mineral. Later, the combination of carbonate and bone meal was selected in order to provide some extra phosphorus also. The special sources of lime and phosphorus used were chosen on the basis of purity, fineness of division, and wholesomeness.

It is impossible to judge the suitability of the formula as regards vitamin content, since little is known as to the vitamin requirements of calves. The feeding of this calf meal has resulted in normal growth in rats from four weeks of age to maturity. On the basis of the ingredients, one would expect it to contain adequate B, to be rather deficient in A, and to be very deficient in C. However, it must be remembered that the calf probably stores some A during the period of whole-milk feeding, and that both A and C are supplied by roughage of the right character as soon as the calf begins to eat it.

The calves

The animals used in the trials here described comprised twelve purebred Holsteins, eight grade Holsteins, and three purebred Shorthorns, all heifers. Because of lack of barn space, the animals in all of the studies, with the exception of one trial, were limited to those available in the university herd. For comparative purposes, animals of the same breed and the same sex were more desirable, and Holsteins were chosen because they were available in the largest numbers. The inclusion of the three Shorthorns was in accordance with a plan to extend the trial to other breeds later.

The animals used were not specially chosen. All the Holstein heifer calves born in the university herd during the experimental period were included in the experiment, with the exception of a few individuals which were deemed too valuable to be used for experimental purposes. At no time was any calf removed from a trial because of lack of thrift or of difficulty in handling the ration, as it was recognized that the ability to induce continuous normal growth in calves which were apparently healthy at the start was the primary measure of the value of the system of feeding.

Feeding and management

The calves were kept in separate stalls and received the same general care that is given to similar animals in the university herd. Each calf was fed whole milk three times a day until the change was made to gruel. This change was usually begun during the fourth or the fifth week, the exact time depending on the condition of the calf.

While the calves were kept on whole milk for about four weeks, it was recognized that this period is somewhat longer than is used in practice, where skimmilk is substituted for whole milk. In previous trials the substitution of gruel was begun as early as two weeks of age, and it was

found that with thrifty calves the change could be made satisfactorily at this time if it was made very gradually. However, the feeding of whole milk up to about four weeks of age gives the animal a better start, so that a more rapid change to gruel, with little or no digestive upset or retardation of growth, can be made. Whole milk was liberally fed during the four weeks, an average of about 12 pounds per calf per day being given.

From two to three weeks were allowed for making the change from milk to gruel, but the period of change was governed by the condition of the calf rather than by any set rule. The beginning and the duration of the period of change are indicated for each calf in connection with figures 1, 2, and 4.

Feeding the calf-meal gruel

The gruel was made by mixing the calf meal with water at about 100° F., in the proportion of 1 to 5 by weight. It was fed three times a day.

In changing from milk to gruel, the first addition of the gruel was one-half pound per feeding. The amount was gradually increased, and the quantity of milk decreased, until the change was complete. The milk and the gruel were fed together. The following feeding schedule was used as a guide during the period of change:

Day	Whole milk (pounds)	Gruel (pounds)
1st	9.0	1.5
5th	7.5	3.0
8th	6.0	4.5
11th	4.5	6.0
14th	3.0	7.5
17th	1.5	9.0
20th	0.0	9.0

It must be emphasized, however, that no set schedule was maintained with any calf. The length of the period of change, the times of increasing the gruel, and the actual amount of milk and gruel fed, were all governed by the condition of the calf. If a given mixture of milk and gruel produced digestive disturbances, as shown by liquid or pasty and foul-smelling stools, no further change was made until these conditions disappeared. If the unhealthy conditions persisted for three or four days, the food was usually cut down in amount temporarily, or perhaps omitted entirely for a feeding. Sometimes, in extreme cases, the proportion of milk to gruel was increased temporarily.

The calf-meal gruel proved palatable, and at all times the amount fed was readily eaten. When the change to the gruel was complete, the gruel was gradually increased according to the appetite and condition of the calf. In general, no increase was made for at least a week after the milk was discontinued, the amount of gruel thus being kept below what might actually be consumed, in order to get the calf well started on the ration containing no milk. If the calf is carried thru the period of change and

excreta, the shape of the belly, and the activity of the animal, all indicate how the feed is being handled. Careful observations were made from day to day of these less expressible measures of growth, and the results were used constantly in regulating the feed of the animals.

Trial 1

The first trial was conducted in the summer and fall of 1921, with seven grade Holstein heifer calves purchased at about three weeks of age from near-by farmers. The calves were brought to the university barn, and were fed whole milk for a period and then gradually changed to the calf-meal gruel. In most cases this change, as shown in figure 1, was started somewhat later than at four weeks of age, due to the age of the calf at the time when it was brought into the barn and the desirability of continuing the milk feeding until the animal was accustomed to its new surroundings.

Results

The growth curves for these calves are shown in figure 1. It is to be noted that these curves do not start at the same point as does the accom-

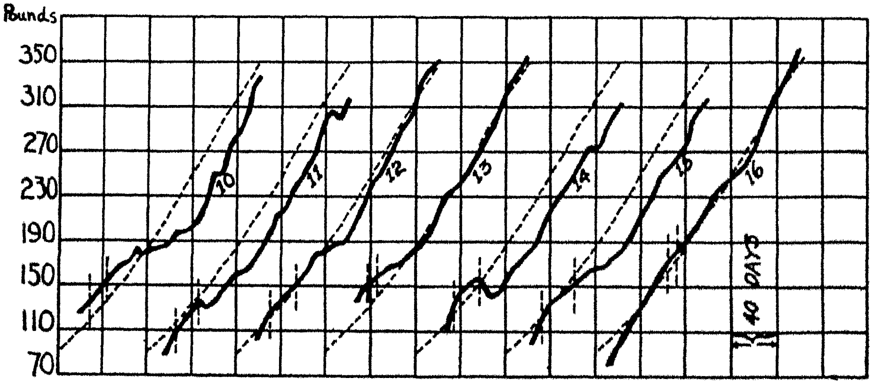


FIGURE 1. CURVES OF GROWTH IN WEIGHT OF GRADE HOLSTEIN HEIFER CALVES, TRIAL I
The dotted curves represent normal growth according to Eckles' data. The vertical dotted lines mark off the period during which the change was made from milk to gruel

panying curve of normal growth. This is due to the fact that, being purchased calves, their birth weights were not known. However, their ages were known, and the first point on the curve represents the weight at the age at which they were received at the university barn. The curves show that the growth was rather irregular, many instances of actual loss of weight being recorded. In several cases, these losses corresponded with periods of extremely hot weather and cannot be charged entirely to the nature of the ration. For all of the calves, except no. 16, the period of change and the subsequent four or five weeks coincided with the hottest months of summer. Thus the results shown were obtained under the most adverse weather conditions. Furthermore, at three or four different times during the period following the change, each calf spent a day in a metabolism

cage, a procedure which had a generally adverse effect on the appetite and the disposition. Some studies in metabolism were made with calf 16 while it was on milk, and this explains why the period of change for this calf was begun later. Thus the animal got a better start on milk than did the others, and this may account for the better and more uniform growth.

Tho figure 1 shows the extent of success in securing continuous normal growth, the actual growth over the period is best indicated in table 2:

TABLE 2. RATE OF GROWTH OF GRADE HOLSTEIN HEIFER CALVES, TRIAL 1

Calf no.	Average daily gain (pounds)
10	1.34
11	1.40
12	1 55
13	1.40
14	1.31
15	1.40
16	1.67
Average	1.44

The average rate of growth of the animals on which Eckles' normal curve was based, was 1.44 pounds per day. The data reported in table 2 show an identical average, a figure, however, which falls considerably short of the 1.71 pounds per day shown in table 1. The averages reported in table 2 do not cover the entire six-months period, since the rate of growth for the first two or three weeks could not be recorded. Omitting this period of slower growth would tend to make the figure reported larger than the true average for the full six months. The calves reported in table 2 were at a disadvantage with respect to those of Eckles, in being grade animals reared during the most unfavorable season and subject to the disturbances of the metabolism cage. On the other hand, they had the advantage of a larger amount of whole milk at the start. Altho they were fed comparably to those reported in table 1, they were poorer individuals and were at a decided disadvantage as regards the time of year in which they were reared.

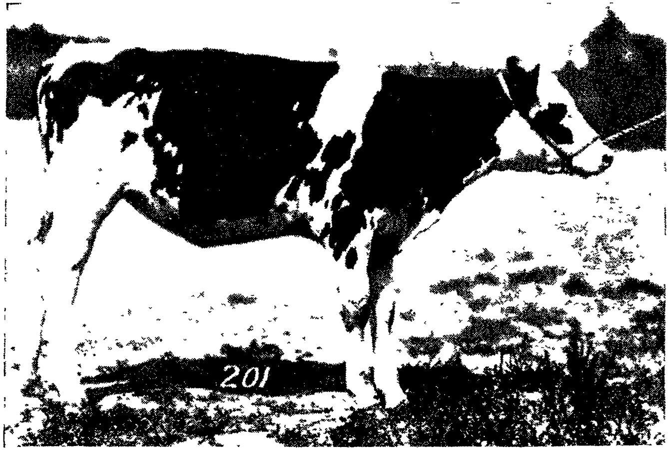
No serious digestive disturbances were caused by the gruel feeding. The periods of retarded growth corresponded in general with those in which the food was cut down because of either lack of appetite or temporary digestive trouble. At the close of the trial all the animals were in good condition and their coats had almost entirely lost any earlier roughness.

The milk and the calf meal consumed during this trial were weighed and recorded as they were fed, but it is not worth while to report the figures because it is not known how much milk was fed prior to the purchase of the calves. The clover hay fed during this trial was of excellent quality.

Plate I

PUREBRED HOLSTEIN HEIFER CALVES AT SIX MONTHS OF AGE, REARED BY THE CALF-MEAL METHOD IN TRIAL 2

The numbers are the same as those used in the text to designate the respective calves


201

135

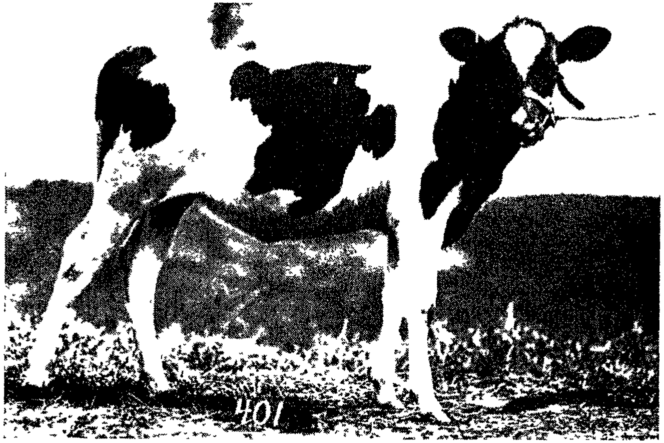
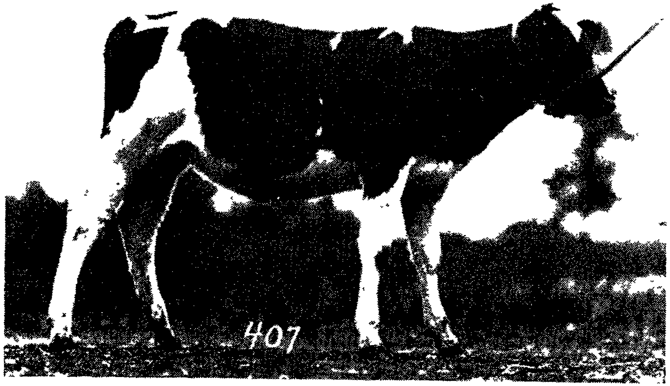
137

200

PLATE II

PUREBRED HOLSTEIN HEIFER CALVES AT SIX MONTHS OF AGE, REARED BY THE CALF-MEAL METHOD IN TRIAL 3

The numbers are the same as those used in the text to designate the respective calves


401

407

408

402

Trial 2

The calves used in the second trial were purebred animals from the university herd, born during the period from October, 1921, to March, 1922, and comprised six Holsteins and two Shorthorns. They were fed according to the procedure previously described, except that the Holstein calves received a certain amount of carrots in addition.

The carrots were added to make up possible vitamin deficiencies in the ration. Carrots are rich in C and contain some A, the two vitamins most likely to be deficient in the system of feeding used. At the time when the change from milk to gruel was begun, carrots, ground in a food chopper and cooked in boiling water for five minutes, were added to the gruel at the rate of one-tenth of a pound of carrots per calf per day. This amount was gradually increased to one-half of a pound per day over a period of two weeks. At this time the cooking was discontinued and the carrots were fed raw on the grain. The amount fed was further increased up to a maximum of one pound per day.

The hay fed during this trial was second-cutting clover containing perhaps 20 per cent of mixed grasses. It was of excellent quality.

Results

The curves for increase in weight of the Holstein calves are shown in figure 2. These curves indicate that the growth of the calves markedly exceeded that shown by the check curve. An observation of greater significance is that the growth was regular, practically paralleling or exceeding the check curve at every period. In particular, no retardation of

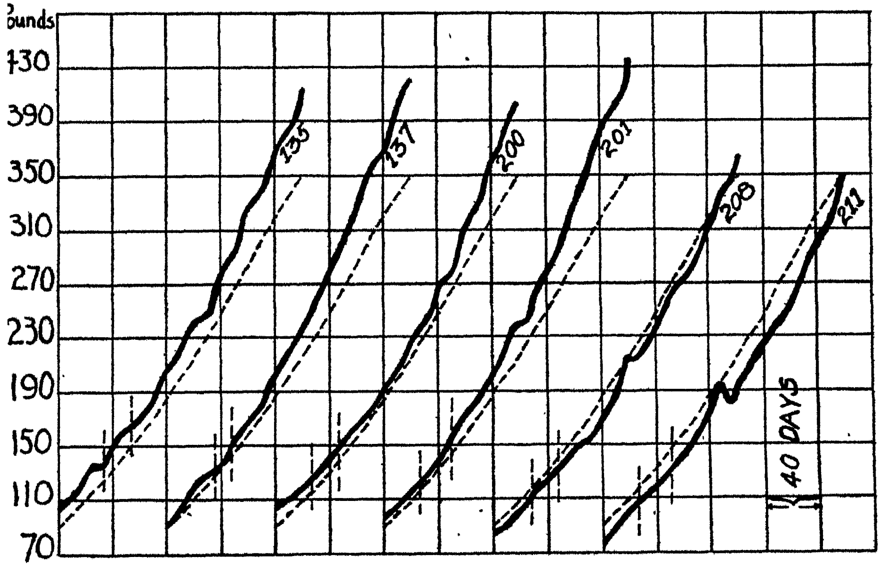


FIGURE 2. CURVES OF GROWTH IN WEIGHT OF PUREBRED HOLSTEIN HEIFER CALVES, TRIAL 2
The dotted curves represent normal growth according to Eckles' data. The vertical dotted lines mark off the period during which the change was made from milk to gruel

growth followed the omission of the milk. This is believed to be an important criterion for the success of any system of rearing calves. If they are to make the best cows, they should grow rapidly and regularly and should not be undernourished or receive any prolonged setback at any period.

That the growth in weight was accompanied by a corresponding skeletal development is shown in figure 3. The all-round development and condi-

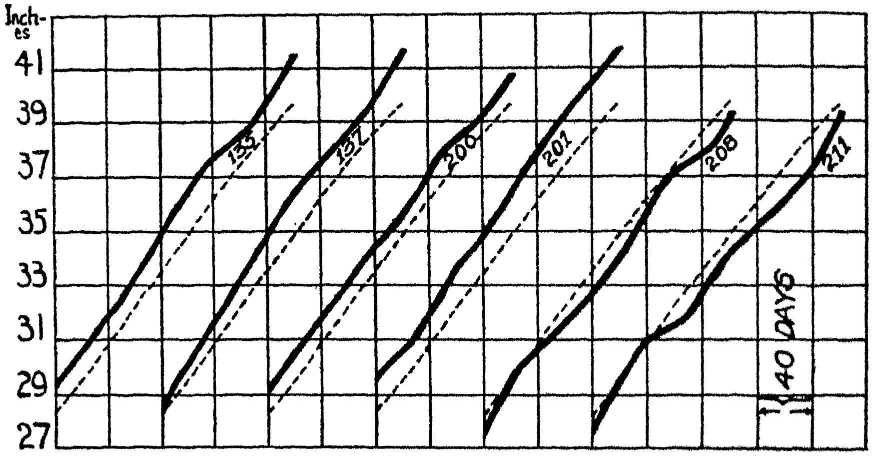


FIGURE 3. CURVES OF GROWTH IN HEIGHT OF PUREBRED HOLSTEIN HEIFER CALVES, TRIAL 2
The dotted curves represent normal growth according to Eckles' data

tion of the calves is shown further in Plate 1. The extent of the growth obtained is best shown in table 3:

TABLE 3. RATE OF GROWTH OF PUREBRED HOLSTEIN HEIFER CALVES, TRIAL 2

Calf no.	Weight at birth (pounds)	Weight at six months (pounds)	Average daily gain (pounds)
135	105	416	1.73
137	90	423	1.85
200	107	408	1.67
201	99	438	1.88
208	88	365	1.54
211	77	350	1.52
Average	94	400	1.70

In making an average daily gain of 1.70 pounds per day, the group of calves reported in table 3 equaled the average gain made by the six animals reported in table 1, which were reared on skimmilk during a nearly identical period. Thus results were obtained comparable in both rate and regularity of growth to those obtained with calves reared on skimmilk.

As is indicated by the regularity of the growth, the calves in this trial experienced little digestive trouble. It is believed that there was little, if any, more occurrence of abnormal feces and of going-off feed than occurred with the group reared on skimmilk.

One of the Shorthorn calves reared in this trial weighed 71 pounds at birth and 350 pounds at six months, making an average daily gain of 1.55 pounds. The other Shorthorn weighed 81 pounds at birth and 329 pounds at six months, making an average daily gain of 1.38 pounds. The normal average daily gain for Shorthorn heifer calves reared on skimmilk as reported by Eckles is 1.35 pounds.

It seems probable that the carrots may have helped in the excellent growth attained in this trial. It was noted that the addition of the carrots stimulated the appetite of the calves and increased the consumption of dry grain. The carrots were eaten readily by five out of six of the calves without any unfavorable effect so far as could be observed.

In a trial conducted in the winter of 1922–23 (the results of which are not included in this bulletin since a different calf-meal formula was used), an attempt was made to compare the growth of two groups of calves fed respectively with and without carrots. In this trial, however, the feeding of the carrots evidently increased the digestive troubles in several cases, and poorer growth resulted. Thus it was concluded that, altho the addition of the carrots might be beneficial in many cases, the probability of their increasing digestive troubles precludes recommendation of their use in the system of feeding under study, and that other sources of vitamins A and C should be sought if further addition of them must be made.

The whole milk and the calf meal were accurately weighed out as they were fed. The amounts consumed thruout the six-months period are shown in table 4:

TABLE 4. MILK AND CALF MEAL CONSUMED BY CALVES, TRIAL 2

Calf no.	Milk consumed (pounds)	Calf meal consumed (pounds)
135	594	340
137	530	359
200	427	335
201	448	366
208	381	314
211	465	302
Average	474	336

The data shown in table 4 are discussed later, in connection with similar data recorded in trial 3.

Trial 3

Eight calves were used in the third trial, comprising six purebred Holsteins, one high-grade Holstein, and one purebred Shorthorn. Since the grade calf was practically a purebred, its records are averaged with those

of the purebreds in the tables. These calves were born during the period from November, 1923, to March, 1924.

In this trial an accurate record was kept of the dry grain and hay consumed, as well as of the milk and the calf meal. A separate supply of grain was weighed out for each calf into a covered pail kept suspended over the stall. The calf was fed three times daily from the supply in its pail, as much being placed in the manger as would be entirely eaten within an hour after feeding. In this way no grain was wasted. When the pail became empty, it was refilled. Thus the grain fed over the six-months period was the sum of the amounts weighed into the pail minus any that was left in the pail at the end of the period. All of the weighings were made by one of the experimenters, and in this way the extra labor and possible errors involved in weighing at each feeding were avoided.

The hay for each calf was weighed into a canvas bag kept suspended by ropes and pulleys over the feeding rack and replenished whenever necessary. Twice a day as much hay was taken from the bag and placed in the manger as the calf would eat readily. In this way, scattering and waste were kept at a minimum. Under each rack was placed a shelf about one foot wide for catching the loose leaves and other fine material that fell thru the manger. Despite all these precautions there was an unavoidable loss from scattering estimated at 10 per cent. This estimated loss was deducted in working up the data for the hay consumption shown in table 6. The hay fed during this trial was a mixed clover and timothy, rather coarse and generally not of the best quality.

Results

The curves of increase in weight for these calves are shown in figure 4. As a group, these calves did not grow as regularly as did those in trial 2. In particular, the curves for calves 401, 402, and 408 show a temporary

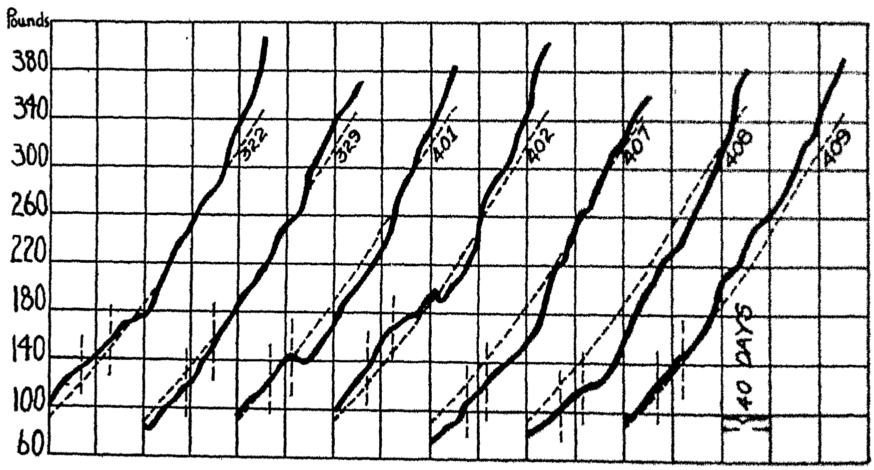


FIGURE 4. CURVES OF GROWTH IN WEIGHT OF PUREBRED HOLSTEIN HEIFER CALVES, TRIAL 3
The dotted curves represent normal growth according to Eckles' data. The vertical dotted lines mark off the period during which the change was made from milk to gruel

retardation of growth following the completion of the change from milk to gruel. In the case of calf 401, at least, this retardation was not due to the feed, but to a bad cold and subsequent lack of appetite. This calf was put back on whole milk for a few days at this period until the cold cleared up. Similarly, calf 407 received some additional whole milk during a period of three days shortly after the completion of the change to gruel, because it was not doing well on the gruel alone.

In no case was the retardation marked or prolonged, and over the entire experimental period all the calves exceeded the growth shown by the normal curve. This is further brought out in table 5:

TABLE 5. RATE OF GROWTH OF PUREBRED HOLSTEIN HEIFER CALVES, TRIAL 3

Calf no.	Weight at birth (pounds)	Weight at six months (pounds)	Average daily gain (pounds)
322	104	410	1.70
329	88	370	1.57
401	98	384	1.59
402	100	405	1.69
407	75	380	1.69
408	84	381	1.65
409	95	393	1.66
Average	92	389	1.65

With the exception of calves 401 and 407, all the calves kept a good appetite thruout the trial, and there was little scouring or other evidence of digestive trouble.

The skeletal development of the calves is indicated by the curves of growth in height shown in figure 5. The condition of the animals at the end of the six-months period is shown in Plate II.

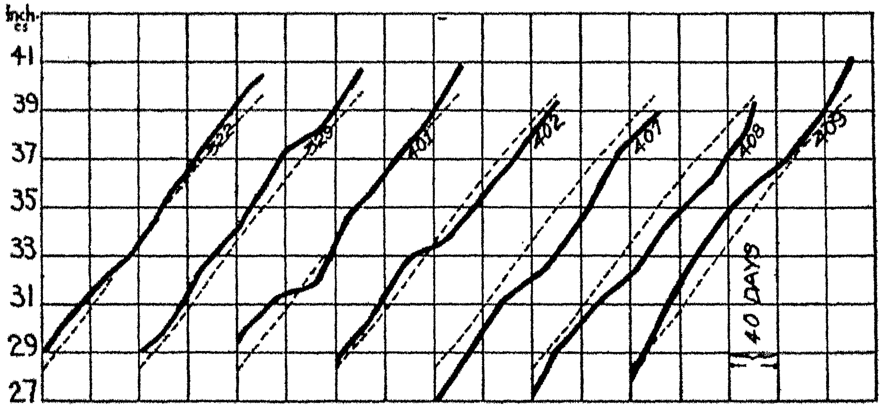


FIGURE 5. CURVES OF GROWTH IN HEIGHT OF PUREBRED HOLSTEIN HEIFER CALVES, TRIAL 3

The dotted curves represent normal growth according to Eckles' data

As a group, the calves reared in trial 3 fell a little short of equaling those of trial 2, both in rate of growth and in general development. The variation here may not be greater than what may be expected from year to year. On the other hand, the somewhat poorer results in trial 3 may have been due to the poorer quality of the hay. The quality and character of hay has a large influence on its rate of consumption by calves, and the question of its nutritive value is a very important one where milk is not fed. It was the authors' observation that less hay was eaten in trial 3 than in trial 2, altho an actual comparison could not be made because records for trial 2 were not available.

Further, the calves in trial 2 received carrots, a practice which is believed to have been advantageous to the animals in question, altho not meriting a safe general recommendation because of the possibility of scouring resulting therefrom, as has already been discussed.

The shorthorn calf reared in trial 3 weighed 83 pounds at birth and 343 pounds at six months of age, the average daily gain thus being 1.14 pounds.

Feed consumption and costs

The amounts of the various feeds eaten by each Holstein calf from birth to six months of age are shown in table 6:

TABLE 6. FEED CONSUMPTION, FROM BIRTH TO SIX MONTHS OF AGE, OF HOLSTEIN CALVES, TRIAL 3

Calf no.	Whole milk consumed (pounds)	Calf meal consumed (pounds)	Hay consumed (pounds)	Dry grain consumed (pounds)
322	473	318	444	174
329	558	284	517	185
401	568	279	356	169
402	499	311	419	133
407	548	265	365	227
408	528	275	338	252
409	450	280	442	186
Average	518	287	412	189

The data in this table show that the average amount of whole milk consumed per calf was 518 pounds, which is 44 pounds more per calf than the average consumption in trial 2 (table 4). The calf meal consumed was correspondingly less in trial 3, as might be expected. A part of the increased consumption of milk in trial 3 was due to the fact that calves 401 and 407 were put back on milk for a few days, after the change to gruel had been completed.

Using the data in table 6, it is possible to compute the cost of rearing a calf by the method under study. For this computation the following prices, applicable at the time the trial was made, were used:

Whole milk	$ 1.92	per hundredweight
G. L. F. calf meal	70.00	per ton
Hominy feed	42.00	per ton

Wheat bran.............	$39.00 per ton
Ground oats.............	45.10 per ton
Oilmeal	53.10 per ton
Mixed hay..............	15.00 per ton

The price for whole milk was the Dairymen's League pool price, 201–210-mile zone, for 3-per-cent milk for the month of January, 1924. The prices used for the G. L. F. calf meal and the other concentrates were the wholesale carload prices f. o. b. Utica, New York, for January, 1924, plus $5 per ton to cover the retail margin.

The price for the hay was an estimated figure for the quality used, based on the price in January, 1924, of hay loose in the mow.

The cost of each kind of feed used and the feed cost per pound of gain were also computed (table 7). For example, the cost of the milk which was fed to calf 322 was found by multiplying the amount of milk fed as shown in table 6 by the price of milk as listed. The feed cost per pound of gain was obtained by dividing the total feed cost for a given calf by its gain as shown in the second column.

TABLE 7. FEED COST OF REARING CALVES TO SIX MONTHS OF AGE, TRIAL 3

Calf no.	Gain (pounds)	Cost of milk	Cost of calf meal	Cost of hay	Cost of dry grain	Total cost	Feed cost per pound of gain
322..............	306	$ 9.08	$10.93	$3.33	$3.75	$27.09	$0.089
329..............	282	10.71	9.94	3.88	3.99	28.52	0.101
401..............	286	10.91	9.74	2.67	3.65	26.97	0.094
402..............	305	9.58	10.89	3.14	2.87	26.48	0.087
407..............	305	10.52	9.28	2.74	4.90	27.44	0.090
408..............	297	10.14	9.63	2.54	5.44	27.75	0.093
409..............	298	8.64	9.80	3.32	4.01	25.77	0.086
Average.......	297	$9.94	$10.03	$3.09	$4.09	$27.15	$0.091

The data given in table 7 are of limited value in one sense, in that feed prices are constantly changing, as is also the price of milk. However, on the basis of the data given in table 6, the farmer can use table 7 as a guide for calculating what he may expect the cost of rearing a calf by this method will be, if his calculations are based on the prices prevailing at the time. Moreover, there is much that can be learned of the usefulness of the calf-meal method from a study of the data in these tables.

The cost figures for the different animals are strikingly uniform, and this fact makes the average significant. If the same feed cost is applied to the milk and the calf meal consumed in the second trial (table 4), the average cost for milk is $9.10 and that for calf meal is $10.66, making a total of $19.76 for these two items. Altho the cost of the milk was greater in trial 3, the cost of the calf meal was correspondingly less, as would be expected, and the total was $19.97, a figure very close to that for trial 2. Since the sum of the milk and calf-meal costs, which makes up more than two-thirds of the total cost of rearing a calf, was not markedly different

in the two trials, the value and the significance of the more complete data in table 7 are thus strengthened.

The primary object of this experiment was not to find out how cheaply a calf could be reared, but to find out how well it could be reared by the method under study. Therefore all the calves were fed liberally. It is believed that the data previously tabulated show that the method will result in satisfactory growth and development. The calves reared in trial 3 made an average gain during the six-months period of approximately 300 pounds, with a corresponding development in size. The feed cost of this gain was $27.15. In comparing this cost figure with those for other methods, the relative gains must be considered also. The total cost in trial 3 could have been lessened by less liberal feeding, but the gains also would have been smaller. Thus the best figure for judging of the economy of the method, and for comparing it with other methods, is the feed cost per pound of gain, shown in the last column of table 7.

LATER DEVELOPMENT OF CALVES REARED IN TRIAL 2 AND IN TRIAL 3

At the time of writing this bulletin, the majority of the calves reared in trial 2 are in the milking herd as three year olds. They all show good size and vigor, and, in so far as it is possible to judge, they have developed into as good cows as those which as calves were reared on skimmilk.

Two of the calves have made excellent production records as two-year-olds. Glista Faith, designated as calf 135 in trial 2, made a yearly record of 14,169 pounds of milk and 495 pounds of fat, and Glista Faun, designated as calf 137 in trial 2, made a yearly record of 10,027 pounds of milk and 367 pounds of fat.

The calves reared in trial 3 have not yet come into milk; but as yearlings they are at no apparent disadvantage when compared with similar animals reared on skimmilk, and give every promise of developing into satisfactory cows.

Thus, in so far as observations can be made to date, calves reared on calf-meal gruel by the method described in this bulletin may be expected to develop into as good cows as those that received skimmilk as calves. Certainly there is no evidence to the contrary.

THE CALF-MEAL METHOD IN PRACTICE

A calf meal has no place in the rearing of calves where there is plenty of skimmilk available for the purpose. The use of skimmilk is a simpler method which, on the whole, will give better results. The use of a calf meal to be fed dry to calves being reared on skimmilk, as recommended by certain manufacturers, is considered an uneconomical procedure. It is believed that a grain mixture of the sort listed on page 8 is fully as good, and it is much less expensive.

Where skimmilk is not available, the use of a calf meal furnishes a method of rearing calves with a limited amount of whole milk, from which gains approximating, if not actually equaling, those made on skimmilk may be expected by following the procedure described in this bulletin.

The best results may be expected by following exactly the method of feeding herein described, but certain changes in the procedure may be

made when the method is not practicable as it stands. The gruel may be fed twice a day instead of three times, altho the latter is the better practice during the early months, as it is with milk. The change to gruel may be begun somewhat earlier than the beginning of the fifth week, or, if made at the latter period, it may be completed somewhat earlier than specified. However, either of these modifications will tend to decrease the rate of gain. If the method is to prove successful, the change cannot be made more quickly or more rapidly than the calf can become sufficiently accustomed to it to avoid marked digestive upsets. Thus the time and the rate of change must be governed by the condition and the vigor of the calf, and cannot be arbitrarily measured in days.

It is believed that the farmer who knows how, and will take the pains, to rear a calf successfully on skimmilk, will have success also with the calf-meal method. The same precautions as regards cleanliness, regularity of feeding, and avoidance of overfeeding, are required with both methods. The gruel method requires some extra care during the period of change and for a short time thereafter, to avoid digestive troubles.

If the results obtained in this paper are compared with those reported for the method of changing directly from whole milk to hay and grain in the early weeks, the use of the calf-meal formula and method of feeding here described may be expected to prove markedly the better in rate and regularity of growth. Eckles (1923) has reported for the method without calf meal that three Holstein calves made an average daily gain of 1.28 pounds from birth to six months of age. Similarly, Hulce, Morrison, and Humphrey (1924) reported an average daily gain, from seventeen days of age to six months, of 1.43 pounds for two Holstein and two Guernsey calves. These figures are markedly lower than the average for the trials reported in this bulletin, but they are based on too few animals to be significant. Furthermore, in both Eckles' study and that of Hulce and his associates, somewhat less whole milk was fed than in the trials reported here. The two methods must be studied side by side to get a definite conclusion as to their relative value, particularly from the standpoint of cost. Therefore the writers do not feel justified in concluding definitely that the calf-meal method is the better, but only offer it for consideration on the basis of the results here obtained.

In any event, the final answer as to the value and practicability of the calf-meal method must come from the farm. In view of the recognized principle that only well-reared calves make the best cows, the fact that the gruel method as described in this bulletin has resulted in better growth and development than has any other method involving the limited use of milk thus far reported, should commend it as worthy of trial to the farmer who has no skimmilk. Whether corresponding results will be obtained in practice which are sufficiently better than where no calf meal is used to justify any extra labor involved, is a question which the individual farmer must answer for himself under his own conditions.

SUMMARY

In this bulletin results are reported of a study of the calf-meal method of rearing calves, using a calf-meal formula and a method of feeding devised by the writers, and involving twenty-three heifer calves. Thirteen

purebred Holstein calves made an average daily gain of 1.67 pounds, reaching an average weight at six months of 394 pounds; seven grade Holsteins made an average daily gain of 1.44 pounds; and three purebred Shorthorns made an average daily gain of 1.46 pounds. These gains are better than any that have been previously reported for the calf-meal method, and are comparable to the results obtained with skimmilk.

The calves grew in height comparably with their increase in weight, and showed a satisfactory development otherwise.

The calves grew regularly over the six-months period, and there was little more scouring or other evidence of digestive trouble than commonly occurs with calves reared on skimmilk.

The calf-meal method requires somewhat more labor and precautions in carrying it out than does the use of skimmilk, and is in general the less satisfactory method.

The use of the calf meal is a much cheaper method than the use of whole milk, and furnishes to farmers who have no skimmilk, or only a limited amount of it, a practical method of rearing calves that is worthy of trial.

The growth and the development obtained by the calf-meal method in these studies markedly exceed any results reported to date where calves have been fed small amounts of whole milk during the first two or three months and then changed to hay and grain alone.

The final decision as to the value and practicability of the calf-meal method must come from the farm.

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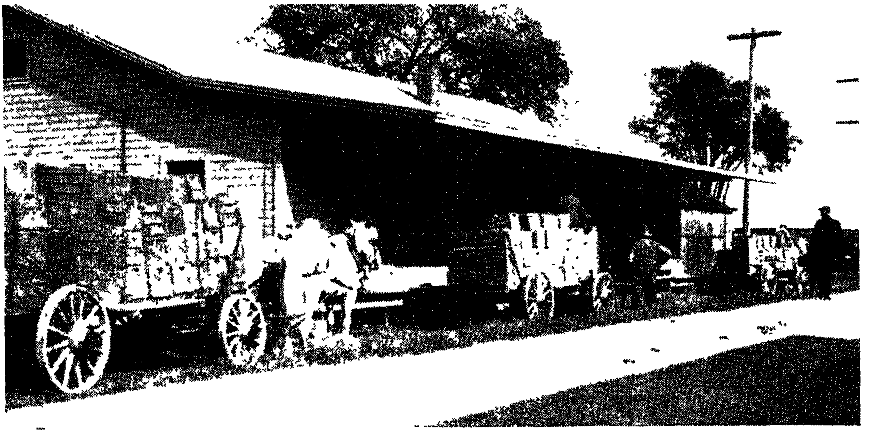
Bulletin 440 June, 1925

An Economic Study of the Marketing of New York Potatoes

M. P. Rasmussen



WAGONLOADS OF POTATOES IN BUSHEL CRATES, WAITING TO BE UNLOADED AT A WESTERN NEW YORK SHIPPING POINT

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CONTENTS

AN ECONOMIC STUDY OF THE MARKETING OF NEW YORK POTATOES[1]

M. P. RASMUSSEN

The margins taken by the various middlemen in all branches of marketing have been much discussed. A great deal of this discussion has been without a clear understanding either of the size of the margin or of the services rendered in return. The purpose of this study was to ascertain these facts in the hope of establishing a fair conception of the necessary costs and services involved in the handling of potatoes at country shipping points and in transporting them to terminal markets.

Studies of several thousand farm businesses in New York have shown that certain farmers are able to raise a bushel of potatoes or produce a can of milk with less labor and at less cost than others. Farm-management studies have analyzed the business methods and practices that have made these differences possible. The results of such studies have enabled farmers to learn both the strong and the weak points of their business and to strengthen those in which better methods have been worked out by others. It was assumed that as great variations in efficiency prevailed in the marketing as in the production of farm products. Therefore, in this study an effort has been made to find some of the factors which affect efficiency in the marketing of potatoes.

Farmers are taking greater interest in the marketing of their products than ever before. Many have had to learn the facts by costly experience. A study of representative potato-marketing agencies may serve as a guide to any organization, farmer-owned or other, which seeks to engage in this field of work, or which, being already engaged, seeks to make its operation more efficient.

AUTHOR'S ACKNOWLEDGMENTS. The investigation herein reported was conducted under the direction of Professors G. F. Warren and C. E. Ladd, and in cooperation with the Bureau of Agricultural Economics, United States Department of Agriculture.

For the season 1921–22, the following potato-shipping organizations or dealers in New York State cooperated in furnishing data: Avoca Cooperative Association, Inc., Avoca; Fremont Cooperative Association, Inc., Hornell; Gainesville Potato Growers' Cooperative Association, Inc., Gainesville; Prattsburg Cooperative Association, Inc., Prattsburg; Saranac Farmers' Cooperative Association, Inc., Cadyville; Steuben Central Cooperative Association, Inc., Wallace; Wayland Cooperative Association, Inc., Wayland; Cheeseman-Munsil Co., Ellenburg Station, F. A. Clark and Son, Brushton; H. I. Doud and Co., Chateaugay; T. B. Humphrey, Churubusco; B. Weirmiller, Wayland; A. Yando, Burke; L. A. Chapin, North Bangor; Oliver and Spellman, Chateaugay; W. W. Capron, Wayland, Datus Clark and Son, Peru; J. H. Colegrove and Son, Canaseraga; Dean, Lee, and Co., Bath; L. S. Gelser and Son, Fillmore; Gledhill and Putnam, Inc., Avoca, Grover and Schultheis, Hornell, Kinkaid Produce Co., Cohocton; and Rowe and Kennedy, Canaseraga.

During the season 1922–23, the following potato-shipping organizations or dealers in New York State furnished data: All of the 1921–22 shipping organizations and dealers with the exception of A. Yando, L. A Chapin, and J. H Colegrove and Son; and, in addition, the following: Peru Potato Growers' Cooperative Association, Inc., Peru; Atlanta Cooperative Association, Inc., Atlanta; Rogersville Potato Growers' Cooperative Association, Inc , South Dansville; Wellsville Potato Growers' Cooperative Association, Inc., Wellsville; Willing Producers' Cooperative Association, Inc , Willing; W. G. Bostwick, Candor; DeWitt and Tucker, Skaneateles; H H. Graham, Beaver Dams; Frank McLean, Cohocton; Fred Litchard, Wellsville; W. W. Finney, Peru; C. S. Mead and Co., Moravia; and W. E. Otto and Co., Atlanta.

Dr. W. I Myers gave constructive and valuable criticism. Mr. A. V Swarthout, of the Bureau of Agricultural Economics, United States Department of Agriculture, contributed helpful information and suggestions.

To these and to many others who have given valuable assistance, the writer is greatly indebted.

[1]Also presented to the Faculty of the Graduate School of Cornell University, September, 1924, as a major thesis in partial fulfillment of the requirements for the degree of doctor of philosophy.

METHODS OF STUDY

Detailed records were obtained by going to private potato-marketing agencies and farmers' cooperative potato-marketing organizations at country points in western and northern New York. While most of these agencies had their headquarters in the counties of Steuben, Allegany, Livingston, Wyoming, Franklin, and Clinton, the operations of many of the larger dealers extended into Cattaraugus, Erie, Genesee, Monroe, Wayne, Ontario, Yates, Schuyler, Chemung, Tompkins, Tioga, Broome, Otsego, Cayuga, and Seneca Counties Several dealers carried on operations in Potter County, Pennsylvania, also. In every case access was freely granted to the books of the organization or the shipper, and car-lot records, as well as detailed costs of operation, were obtained. Twenty-four records were obtained covering the 1921–22 shipping season, and thirty-four records for the 1922–23 season. This study did not include the Long Island area. The number of records obtained, and the types and approximate locations of the shipping agencies, are shown in table 1:

TABLE 1. NUMBER OF RECORDS OBTAINED, AND TYPE AND LOCATION OF SHIPPING AGENCY, SEASONS 1921–22 AND 1922–23

Type of agency *	1921–22				1922–23			
	Number of records obtained			Number of loading stations	Number of records obtained			Number of loading stations
	Western New York	Northern New York	Total		Western New York	Northern New York	Total	
Farmers' cooperative associations	6	1	7	7	10	2	12	12
Single-station dealers	1	7	8	8	5	5	10	10
Many-station dealers	8	1	9	203	10	2	12	202
Total	15	9	24	218	25	9	34	224

* The types of agencies are defined on page 5.

TABLE 2. VOLUME OF POTATOES COVERED BY THIS STUDY, SEASONS 1921–22 AND 1922–23

Type of agency	1921–22			1922–23		
	Bushels shipped	Per cent of total	Approximate number of carloads of 600 bushels	Bushels shipped	Per cent of total	Approximate number of carloads of 600 bushels
Farmers' cooperative associations	423,992	12 1	706	468,906	16 9	781
Single-station dealers	420,813	11 9	702	357,961	12 9	595
Many-station dealers	2,671,957	76.0	4,453	1,949,179	70 2	3,247
Total	3,516,762	. .	5,861	2,776,046	......	4,623
Approximate per cent of all up-state potatoes shipped in carloads during the season	41.49			38.4		
Approximate per cent of total production of State for the season	10.3			7.4		

Data were obtained on approximately 41 per cent of the up-state potatoes shipped in carload lots during the 1921–22 season, and on approximately 38 per cent of those shipped during the 1922–23 season. For the 1921–22 season, the data covered about 10 per cent of the estimated total production of the State; for the 1922–23 season, about 7 per cent. (Table 2)

The shipping points covered by this study are shown in figures 1 and 2. The data cover shipments from 152 stations for the 1921–22 season, and from 151 stations for the 1922–23 season.

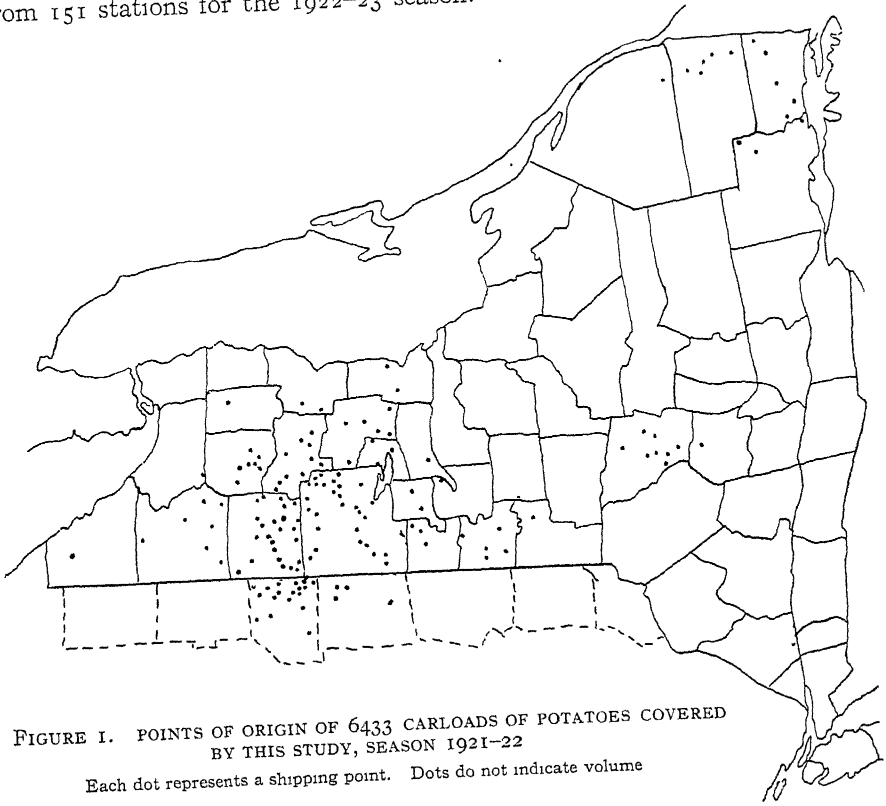


FIGURE 1. POINTS OF ORIGIN OF 6433 CARLOADS OF POTATOES COVERED BY THIS STUDY, SEASON 1921–22

Each dot represents a shipping point. Dots do not indicate volume

AGENCIES FOR RENDERING NECESSARY SERVICES

The types of agencies for receiving and shipping potatoes, which operated in the areas studied during the seasons 1921–22 and 1922–23, included six fairly distinct groups, all of which competed directly with one another at some shipping points. These types were:

(a) Farmers' cooperative associations.

(b) Private dealers loading at one station only, and designated in this study as "single-station dealers."

(c) Private dealers loading at from five to fifty different stations, but with main offices in the producing area, designated in this study as "many-station dealers."

(d) City wholesale houses or line houses which maintained loading stations in the producing area.

(e) Chain stores which maintained at least one loading station and buying office in the producing area.

(f) The intermittent, or "fly-by-night," private dealer, who bought potatoes only occasionally, who did not maintain an office, who did only a car-door business, and who loaded only when and where an opportunity for profit seemed certain.

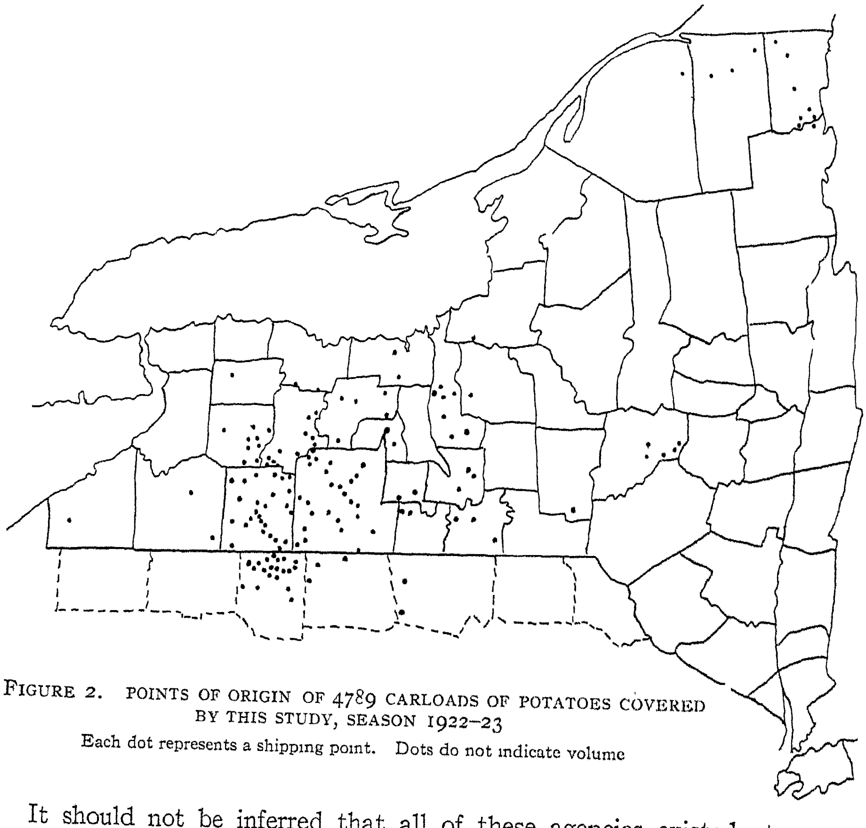


FIGURE 2. POINTS OF ORIGIN OF 4789 CARLOADS OF POTATOES COVERED BY THIS STUDY, SEASON 1922–23

Each dot represents a shipping point. Dots do not indicate volume

It should not be inferred that all of these agencies existed at every shipping point in the areas studied. At many points there were only two or three of these agencies, at some points there were as many as six (figure 3).

The agencies that were studied in detail were farmers' cooperative associations, single-station dealers, and many-station dealers with main offices in the potato-producing area. There were only two line houses and one chain store operating loading stations in the area studied, and the main offices of these firms, with their records, were located in distant terminal markets. They were therefore omitted from this study. Their method of operation was essentially the same as that of the many-station dealers, discussed later in detail. The intermittent, or "fly-by-night,"

FIGURE 3. SCALE HOUSES AND OFFICES OF 5 COMPETING DEALERS AT SOUTH WAYLAND, STEUBEN COUNTY, NEW YORK

Three dealers share the scale house and the office in the center

type of dealer was also omitted because of the practical impossibility of locating such operators and the probability that no records were kept by them.

NEW YORK AS A POTATO-PRODUCING STATE

Potatoes have been produced in New York since the year 1718.[2] By 1849, when the seventh national census was taken, the crop had assumed considerable importance.

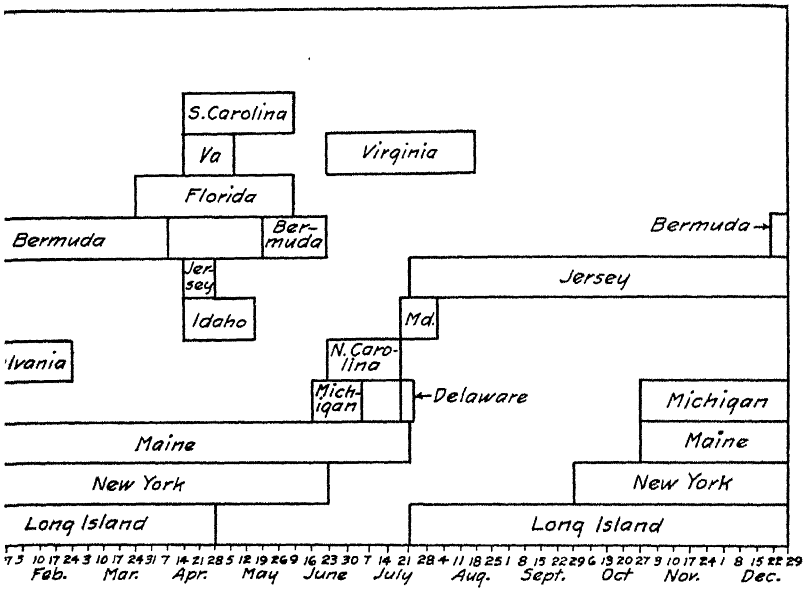
During the past fourteen years New York has produced an average of about 35,144,000 bushels of potatoes annually, or approximately 7 per cent of the total production for the United States. The census of 1920 places the value of the New York potato crop for 1919 at $69,812,321, or approximately 17 per cent of the value of all crops of the State for that year. Hay was the only New York crop which exceeded potatoes in value. While the farm value of the hay crop was greater than that of the potato crop, potatoes are a more important market and cash crop than hay. No data are available concerning the shipments of hay in New York during the 1919–20 season, but the receipts of hay at twelve markets in the United States during that period were 1,613,823 tons, or approximately 121,106 carloads.[3] For the same period 167,870 carloads of potatoes moved to market in the United States. The approximate farm value of a carload of hay (12½ tons at $20.45) during that period was $255.62; the approximate average farm value of a carload of potatoes (600 bushels at $1.483) was $889.80.[4]

New York is one of nineteen important late-potato-shipping States. The potato crop of New York comes into direct competition with the crops of

[2] New York State Agr. Soc. Trans. **8**: 945. 1848.
[3] U. S. Agr. Dept. Yearbook **1922**: 677, 690, 1011.
[4] U. S. Agr. Dept. Yearbook **1920**: 611–631.

ıe, Pennsylvania, Michigan, and Wisconsin, and into indirect compe- ı with those of Minnesota, North and South Dakota, Nebraska, rado, and Idaho. The annual production of potatoes for these ıs for the period 1915–1923 is given in table 3 (page 10).

.e New York potato crop meets competition also from some of the ·s producing the early or the mid-season crop, notably Florida, South lina, Virginia, and New Jersey, as well as from the Bermuda Islands.



E 4. PERIODS DURING WHICH POTATOES FROM VARIOUS STATES WERE QUOTED ON THE NEW YORK MARKET, CALENDAR YEAR 1923

ıg the spring of 1923, Bermuda potatoes were on the market in New City from January 1 to April 7. Florida potatoes made their appear- about March 20 and were last quoted on June 2. Virginia potatoes quoted on April 14 and dropped off about May 5, to reappear again June 10 and last until August 18. South Carolina potatoes could .d in the New York market from April 14 to June 2. The North ina potato crop during 1923 filled in the gap between seasons. The vare and Maryland crop competed slightly with the first offerings Long Island during the second and third weeks in July. New Jersey oes were offered on the New York market at approximately the same as Long Island potatoes.[5] The States of origin of potatoes sold on large terminal markets are shown in figures 4 to 6.

› bulk of the late, or main, crop of potatoes is produced in Maine, York, Pennsylvania, Michigan, Wisconsin, and Minnesota.

ıblished data gathered by D. B. Wilson, graduate student at Cornell University, from a study of he *Chicago Packer* for the year 1923.

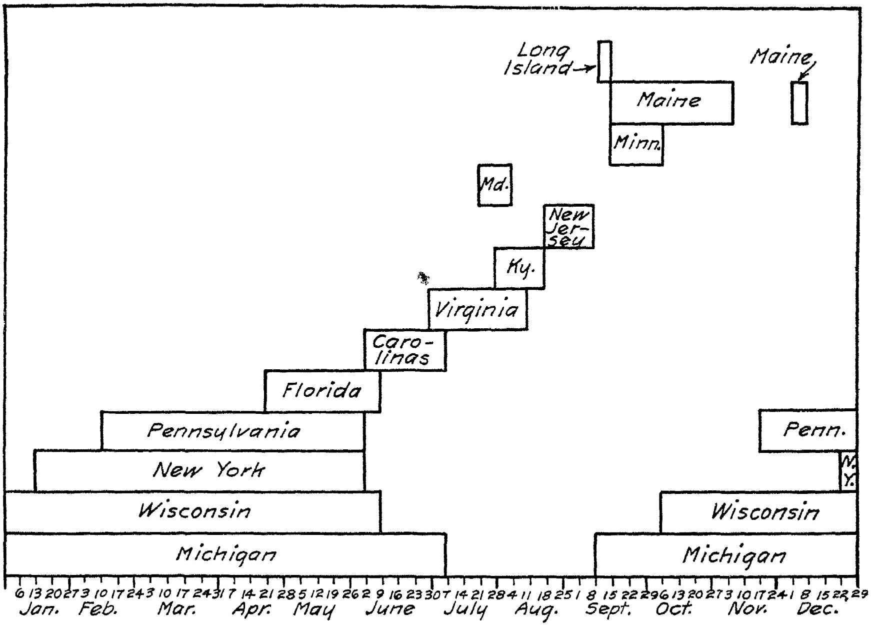


FIGURE 5. PERIODS DURING WHICH POTATOES FROM VARIOUS STATES WERE QUOTED ON THE PITTSBURGH MARKET, CALENDAR YEAR 1923

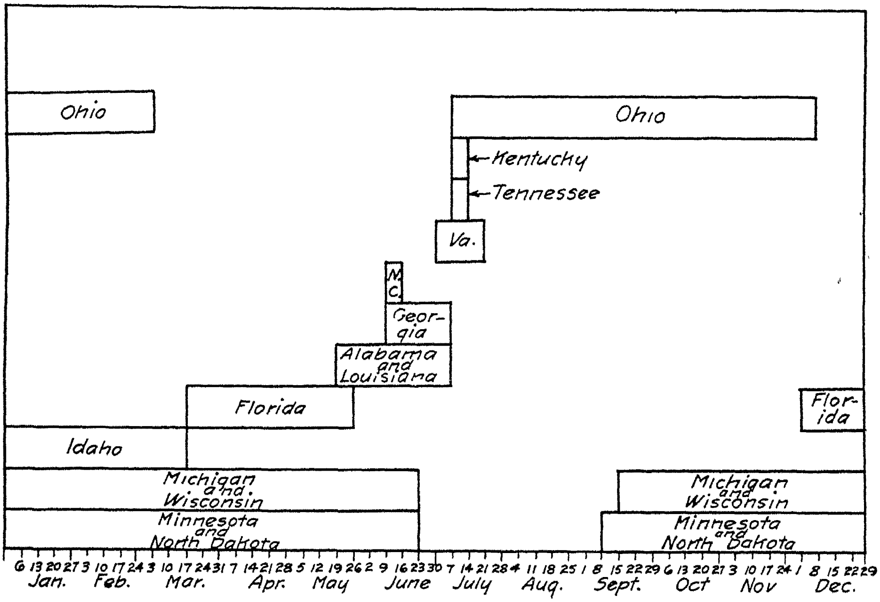


FIGURE 6. PERIODS DURING WHICH POTATOES FROM VARIOUS STATES WERE QUOTED ON THE CINCINNATI MARKET, CALENDAR YEAR 1923

NEW YORK AS A POTATO-SHIPPING STATE

In a recent bulletin,[6] the United States Department of Agriculture furnished data concerning the disposal of the main, or late, potato crop of the United States, covering the five-years period 1917–1922, as follows:

> About 58 per cent of the combined early and late potato crop of 1919 was reported sold, according to the census returns. Evidently 42 per cent of the potato crop was retained on the farms. Allowing 10 per cent of the total crop for seed and 20 per cent more for shrinkage, stock feed, and decay, there remained about 11½ bushels per farm to be eaten by the people on the 3,000,000 farms which produce potatoes.
>
> The census report says that only about one-half of the farms produce potatoes even for home use, so, evidently, part of the potatoes not sold in city markets are used on other farms. Apparently about one-third to one-half of the potatoes sold are not shipped in carload quantities, but are trucked directly to market or sold from the farms in small lots.

The disposal of the average of estimated crops for 1917–1921 is figured as follows:

> Making the same 30 per cent allowance for waste, seed, etc., and taking out about 25 per cent as shipped in car lots, there remains about 45 per cent of the crop to be sold in small lots and consumed on farms.

From 25 to 30 per cent of the main, or late, crop of potatoes of the United States appears to have been grown for sale and to have gone through the usual channels of commercial distribution.

An approximation of the proportion which the commercial crop is of the total crop, for New York and the States with which it directly competes, is given in table 3. During the five-years period 1917–1922, approximately

TABLE 3. AVERAGE PRODUCTION FOR FIVE SEASONS, CAR-LOT SHIPMENTS, AND PERCENTAGE OF POTATO SHIPMENTS, FROM MAIN-CROP STATES, SEASONS 1917–18 TO 1921–22*

State	Production		Car-lot shipments	Per cent of crop shipped
	Bushels	Cars of 600 bushels		
Idaho	7,536,800	12,561	8,896	70.82
Colorado	11,611,000	19,351	12,814	66.21
Maine	25,120,600	41,868	22,610	54.07
Minnesota	30,870,000	51,450	22,983	44.46
Wisconsin	30,302,000	50,503	17,218	34.50
North Dakota	7,256,800	12,095	3,489	28.04
Michigan	30,979,000	51,632	12,976	25.13
New York	36,729,000	61,215	13,690	22 36
Nebraska	9,039,200	15,065	3,176	21.08
South Dakota	6,449,000	10,748	1,644	15.29
Pennsylvania	24,961,600	41,603	3,930	9.44

* U. S. Agr. Dept. Farmers' bul. 1317 : 3. 1923.

22 per cent of the New York crop was shipped in car lots, or an annual average of about 13,690 carloads of 600 bushels each. No data have been gathered covering the volume of potatoes shipped in trucks, but there can be no doubt that a large volume were so handled, particularly within a radius of from 50 to 75 miles of the New York up-state cities. In the

[6] U. S. Agr. Dept. Farmers' bul. 1317 : 1–5. 1923.

northern New York area, shippers at former loading points west of Malone stated that a large part of the potatoes produced there were now hauled by trucks to cities and towns in St. Lawrence and Jefferson Counties. A great deal of trucking of potatoes was done within a 50- to 75-mile radius of Syracuse, Rochester, and Buffalo, and in central and western New York.

In many instances potatoes hauled in trucks were sold directly to the retailer or to the consumer. If the truck operator went directly to the farmer for his load of potatoes, delivery to, as well as handling by, the local shipper was eliminated, brokerage was saved, and no warehouse costs were incurred. If the potatoes were sold directly to the consumer in the city, the services of the city wholesaler and retailer were eliminated, as well as the costs of unloading and delivering. Over against these possible savings, the cost of operating the truck and the carrying of a relatively small volume of potatoes would have to be compared with a comparatively low freight rate on a large volume of potatoes.

In the 1921–22 season, the carload shipments of New York potatoes totaled 18,963, or approximately 11,377,800 bushels. Of the total estimated production of 33,990,000 bushels, about 33 per cent moved in carload lots. In the 1922–23 season, the carload shipments of New York potatoes totaled 19,235, or approximately 11,541,000 bushels. Of the total estimated production of 37,400,000 bushels, approximately 31 per cent moved in carload lots.

Data have been made available by the Bureau of Agricultural Economics, United States Department of Agriculture, bearing on points of origin and number of carloads of potatoes shipped in New York State during the seasons 1920–21, 1921–22, and 1922–23 (table 4). During these three seasons, 19 out of 52 counties shipped, on the average, more than 100 cars

TABLE 4. CARLOAD SHIPMENTS, BY COUNTIES, OF NEW YORK WHITE POTATOES, SEASONS 1920–21, 1921–22, AND 1922–23

County	Number of carloads shipped					Average per cent of total shipments
	1920–21	1921–22	1922–23	Total for three seasons	Average for three seasons	
Albany	...	...	1	1	...	...
Allegany	915	1,665	996	3,576	1,192	6.45
Bronx	...	1	...	1	...	...
Broome	62	89	16	167	56	...
Cattaraugus	36	135	52	223	74	...
Cayuga	274	252	226	752	250	1 36
Chautauqua	25	30	16	71	24	...
Chemung	49	57	16	122	41	...
Chenango	91	133	40	264	88	...
Clinton	382	494	515	1,391	464	2 51
Columbia	...	1	1	2	1	...
Cortland	379	491	237	1,107	369	2.00
Delaware	21	32	10	63	21	...
Dutchess	4	4	2	10	3	...
Erie	15	87	122	224	75	...
Essex	20	37	60	117	39	...
Franklin	485	905	534	1,924	641	3.47

TABLE 4 (*concluded*)

County	Number of carloads shipped					Average per cent of total shipments
	1920–21	1921–22	1922–23	Total for three seasons	Average for three seasons	
Genesee	542	687	1,137	2,366	789	4.26
Herkimer	1	8	...	9	3	...
Jefferson	...	1	...	1	...	...
Lewis	20	...	2	22	7	...
Livingston	593	595	713	1,901	634	3.43
Madison	66	120	39	225	75	...
Monroe	826	467	1,018	2,311	770	4.17
Nassau	7	9	6	22	7	...
Niagara	1	1	2	4	1	...
Oneida	27	109	12	148	49	...
Onondaga	520	478	302	1,300	433	2.34
Ontario	1,147	772	1,196	3,115	1,038	5.61
Orange	2	2	2	6	2	...
Orleans	82	81	75	238	79	...
Oswego	87	47	64	198	66	...
Otsego	172	277	126	575	192	1.04
Queens	...	5	...	5	2	...
Rensselaer	10	4	15	29	10	...
St. Lawrence	6	14	6	26	9	...
Saratoga	1	3	1	5	2	...
Schenectady	...	...	1	1	...	...
Schoharie	6	7	1	14	5	...
Schuyler	191	216	144	551	184	0.99
Seneca	53	41	35	129	43	...
Steuben	2,838	3,408	2,511	8,757	2,919	15.78
Suffolk	5,641	4,829	7,185	17,655	5,885	31.82
Sullivan	...	2	...	2	...	...
Tioga	221	399	130	750	250	1.35
Tompkins	203	278	151	632	211	1.14
Ulster	1	...	...	1	...	...
Warren	1	...	...	1	...	...
Wayne	392	211	367	970	323	1.75
Washington	162	121	102	385	128	0.69
Wyoming	550	1,260	970	2,780	927	5.01
Yates	138	78	78	294	98	...
State total	17,279	18,963	19,235	55,443	18,479	...

of potatoes a year. These 19 counties shipped approximately 95 per cent of the total amount that moved to the market by rail. Only 4 of these 19 counties shipped more than 1000 cars each, Suffolk County leading with 5885, Steuben following with 2919, Allegany with 1192, and Ontario with 1038. These counties alone shipped approximately 59 per cent of the state total, Suffolk County shipping 31.8 per cent, Steuben 15.7 per cent, Allegany 6.4 per cent, and Ontario 5.6 per cent.

Exclusive of the counties on Long Island, there were only 29 stations in New York reporting average shipments of 100 carloads or more for these three seasons (table 5).[7]

[7] A complete list of shipments by stations and counties is given in the appendix (page 155).

TABLE 5. UP-STATE STATIONS IN NEW YORK SHIPPING AN AVERAGE OF 100 OR MORE CARLOADS OF POTATOES ANNUALLY, SEASONS 1920–21, 1921–22, AND 1922–23

County	Station	Number of carloads shipped			
		1920–21	1921–22	1922–23	Average for three seasons
Allegany	Andover	191	330	207	243
	Canaseraga	148	233	120	167
	Fillmore	79	159	99	112
	Wellsville	166	273	207	215
	Whitesville	111	169	118	133
Clinton	Cadyville	44	183	213	147
Franklin	Chateaugay	191	335	199	242
	Malone	42	240	132	138
Genesee	Batavia	69	116	141	109
	Stafford	126	116	165	136
Livingston	Dansville	142	167	145	151
Monroe	Honeoye Falls	130	60	142	111
Ontario	Holcomb	127	65	131	108
	Naples	210	219	182	204
	Phelps	117	78	114	103
	Victor	170	109	175	151
Steuben	Arkport	201	224	186	204
	Atlanta	197	257	192	215
	Avoca	202	237	186	208
	Cohocton	280	352	252	295
	Hornell	146	202	83	144
	Prattsburg	214	216	228	219
	Rogersville	165	217	144	175
	Wallace	329	400	270	333
	Wayland	261	345	269	292
	Wayland Station	177	216	152	182
Wyoming	Bliss	63	210	116	130
	Gainesville	116	216	228	187
	Hardys	84	206	160	150

The distribution of the potatoes to cities that received 35 or more carloads during the seasons 1921–22 and 1922–23 is shown in table 6. In the first season, approximately 72 per cent of the carloads went to 21 large cities and 1823 carloads went to 428 small cities and towns. In the second season, about 68 per cent went to 17 large cities and 1556 car loads went to 330 small cities and towns. The bulk of the car-lot shipments during both seasons went to large terminal markets.

New York City received only 9.4 per cent of the potatoes included in this study during the 1921–22 season and only 17.1 per cent during the 1922–23 season. In 1921–22, Pittsburgh apparently offered a better market for New York State potatoes than did New York City, while Cleveland, Philadelphia, and Washington seem to have been almost as attractive. In 1922–23, the market outside of New York City, but within the State, was apparently more attractive than was New York City itself. While cities within the State received 46 per cent of the potatoes shipped by the agencies studied, only 17.1 per cent went to the New York City market. (Table 6.)

TABLE 6. DESTINATIONS OF POTATOES COVERED BY THIS STUDY, CARLOADS OF 600 BUSHELS, SEASONS 1921–22 AND 1922–23

Cities receiving 35 or more carloads

1921–22			1922–23		
City	Number of cars	Per cent of total shipment	City	Number of cars	Per cent of total shipment
Pittsburgh, Pa.	775	12.0	New York, N. Y.	817	17.1
New York, N. Y.	602	9.4	Brooklyn, N. Y.	670	14.0
Cleveland, Ohio	532	8.3	Newark, N. J.	275	5.7
Philadelphia, Pa.	495	7.7	Cleveland, Ohio	259	5.4
Washington, D. C.	433	6.7	Philadelphia, Pa.	219	4.6
Newark, N. J.	334	5.2	Pittsburgh, Pa.	183	3.8
Baltimore, Md.	272	4.2	Jersey City, N. J.	174	3.6
Brooklyn, N. Y.	241	3.7	Scranton, Pa.	123	2.6
Youngstown, Ohio	159	2.5	Baltimore, Md.	115	2.4
Jersey City, N. J.	131	2.0	Schenectady, N. Y.	69	1.5
Akron, Ohio	90	1.4	Bridgeport, Conn.	68	1.4
Clarksburg, W. Va.	86	1.3	Burlington, Vt.	49	1.0
Richmond, Va.	85	1.3	Paterson, N. J.	49	1.0
Jacksonville, Fla.	68	1.1	Washington, D. C.	48	1.0
Albany, N. Y.	55	0.9	Jacksonville, Fla.	39	0.8
Wheeling, W. Va.	51	0.8	Troy, N. Y.	38	0.8
Harrisburg, Pa.	44	0.7	Hartford, Conn.	38	0.8
Indianapolis, Ind.	42	0.65			
Elizabeth, N. J.	41	0.65			
Atlanta, Ga.	38	0.6			
Schenectady, N. Y.	36	0.55			
428 miscellaneous destinations	1,823	28.35	330 miscellaneous destinations	1,556	32.5
Total	6,433	100.00		4,789	100.00

TABLE 7. DISTRIBUTION, BY STATES, OF POTATOES COVERED BY THIS STUDY, 600-BUSHEL CARLOADS, SEASONS 1921–22 AND 1922–23

	1921–22				1922–23		
State	Number of carloads shipped	Per cent of total shipment	Number of destinations	State	Number of carloads shipped	Per cent of total shipment	Number of destinations
Pennsylvania	1,636	25.43	100	New York	2,205	46.03	117
New York	1,332	20.71	95	New Jersey	721	15.06	48
Ohio	1,040	16.17	64	Pennsylvania	731	15.26	74
New Jersey	842	13.09	59	Ohio	316	6.60	15
(District of Columbia)	437	6.79	2	Connecticut	194	4.05	14
Maryland	311	4.83	8	Massachusetts	142	2.97	20
West Virginia	215	3.34	30	Maryland	121	2.53	4
Virginia	181	2.81	21	Vermont	74	1.55	9
North Carolina	127	1.97	25	West Virginia	55	1.15	10
Florida	71	1.11	4	(District of Columbia)	48	1.00	1
South Carolina	67	1.04	8	Florida	43	0.90	3
Georgia	60	0.93	7	North Carolina	40	0.84	9
Indiana	45	0.70	4	Rhode Island	37	0.77	4
Connecticut	34	0.53	8	Virginia	22	0.46	6
Massachusetts	11	0.17	3	Georgia	15	0.31	2
Alabama	8	0.12	2	New Hampshire	13	0.27	5
Kentucky	7	0.11	2	South Carolina	11	0.23	5
Delaware	3	0.05	2	(Canada)	1	0.02	1
New Hampshire	2	0.03	2				
Vermont	2	0.03	1				
Tennessee	1	0.02	1				
Maine	1	0.02	1				
Total	6,433	100.00	449		4,789	100.00	347

In 1921–22, the up-state New York agencies that cooperated in this study shipped 6433 carloads of potatoes to 449 primary destinations in 21 States and the District of Columbia (table 7). The four States leading

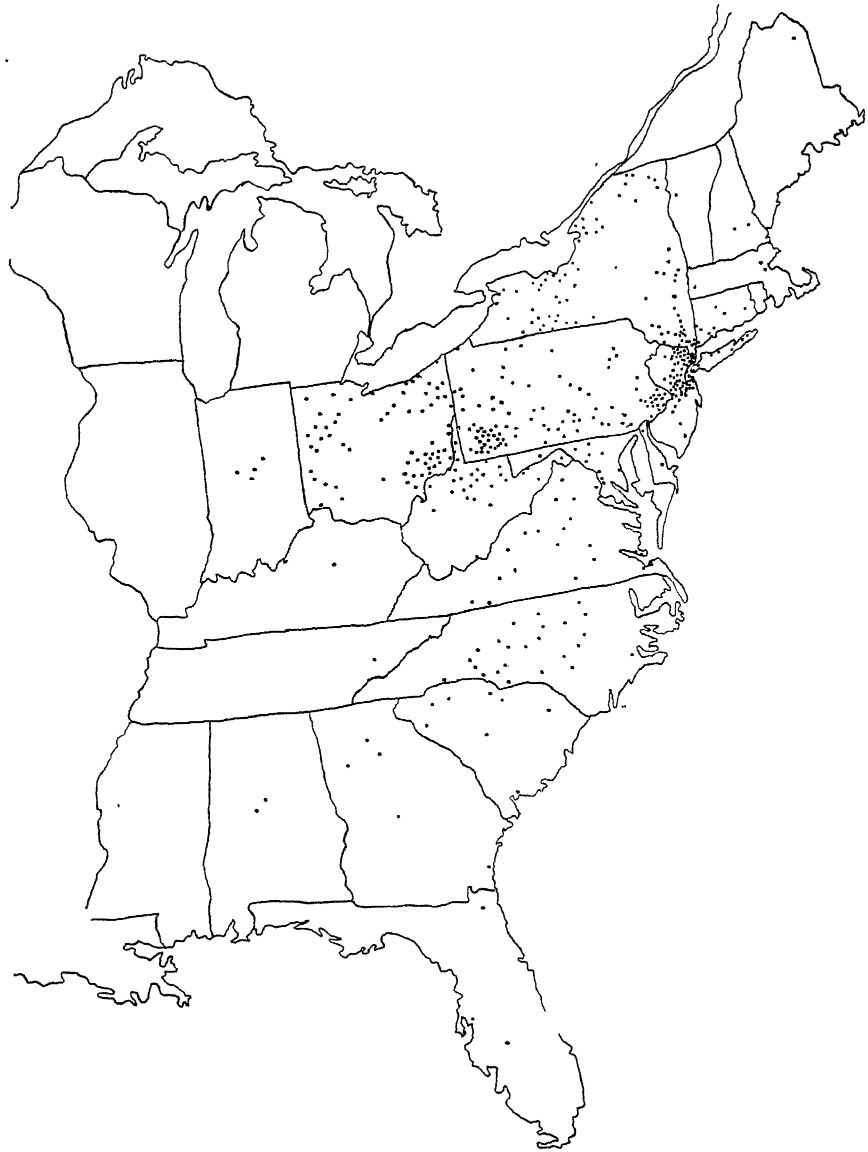


FIGURE 7. DISTRIBUTION OF 6433 CARLOADS OF POTATOES COVERED IN THIS STUDY, SEASON 1921–22

Each dot represents a primary destination. Dots do not indicate volume

in the receipts of these potatoes were: Pennsylvania, with 1630 cars, or about 25 per cent; New York, with 1332 cars, or about 21 per cent; Ohio, with 1040 cars, or 16 per cent; and New Jersey, with 842 cars, or 13 per

FIGURE 8. DISTRIBUTION OF 4789 CARLOADS OF POTATOES COVERED IN THIS STUDY, SEASON 1922–23

Each dot represents a primary destination. Dots do not indicate volume

cent. Pennsylvania thus received about 304 cars more than did New York State, while Ohio and New Jersey received, respectively, 292 and 490 cars less than did New York State. A large number of cars went west and south of the State during the 1921–22 season (figure 7).

In 1922–23, the cooperating agencies shipped 4789 carloads of potatoes to 347 primary destinations in 16 States, the District of Columbia, and Canada. Of this total, the four States leading in receipts were: New York, with 2205 carloads, or about 46 per cent; New Jersey, with 721 carloads, or about 15 per cent; Pennsylvania, with 731 carloads, or about 15 per cent; and Ohio, with 316 carloads, or about 7 per cent. A large number of carloads went to eastern destinations, while only a relatively small number went to southern and western points (figure 8). This was in sharp contrast to conditions during the previous season (table 8),

TABLE 8. PERCENTAGE OF TOTAL SHIPMENTS OF NEW YORK POTATOES TO EAST, WEST, AND SOUTH, SEASONS 1921–22 AND 1922–23*

Area	1921–22		1922–23	
	Number of carloads	Per cent of total	Number of carloads	Per cent of total
East	3,860	60 00	4,116	85 95
West	1,085	16 87	316	6 60
South	1,488	23 13	357	7.45
Total	6,433	100 00	4,789	100.00

* The territory east of the Ohio-Pennsylvania line and north of Mason and Dixon's line is here classified as "east," all territory west thereof as "west," and all territory south of Mason and Dixon's line as "south."

and this shift in primary destinations from west to east illustrates the competitive conditions which New York shippers are obliged to meet.

Because of its location, Maine ships its potatoes south and west. In a normal year Maine will very largely supply the New England States and contribute substantially to the New York City market and to the Hudson Valley cities. Up-state potatoes usually sell for less than do Maine potatoes, and, with a normal crop in Maine, are subject to severe competition in the East. In the West, New York competes directly with Michigan and Wisconsin for middle-western and southern markets. These two States in turn are subject to severe competition from the more westerly potato areas in Minnesota, North and South Dakota, Colorado, and Idaho. These last-named States, by shipping to the middle-western markets, have a tendency to force Wisconsin and Michigan potatoes farther east into competition with the New York, the Pennsylvania, or even the Maine, potatoes.

The freight rates in force in 1923 from competing potato areas to certain terminal markets are indicated in table 9. The western New York area had practically the same freight rate to New York City, Pittsburgh, and Cleveland. On the basis of freight rates, however, Pittsburgh and Cleveland were attractive markets for Wisconsin and Michigan potatoes, and

TABLE 9. FREIGHT RATES FROM COMPETING AREAS TO TERMINAL POINTS

(Carload rate, in cents per 100 pounds, March, 1923)

From	To			
	New York	Pittsburgh	Cleveland	Chicago
Presque Isle, Me	55.5	60.5	64.0	78.0
Cadillac, Mich	60.0	38.0	33.5	32.0
Waupaca, Wis	67.0	44.5	40.0	20.5
Moorehead, Minn	82.5	60.0	57 5	41.5
Fargo, N. Dak	82 5	60.0	57.5	41.5
Avoca, N. Y	28 5	28.0	27.0	39 5
Riverhead, L. I.	17.0	44.0	50.0	66.5
Chateaugay, N. Y	34.0	47.5	40.0	....

these competed strongly with the up-state New York stock. On the other hand, Boston and New York City were the logical destinations for Maine and Long Island potatoes.

In 1921, Maine had a total crop of 38,442,000 bushels, which was approximately 63 per cent larger than its average for the eight-years period 1915–1922 inclusive. This large crop contributed substantially to an oversupply in New York City and other eastern markets, and forced up-state shippers to seek other outlets. During the same year New York had practically an average crop, whereas the crops for Michigan, Wisconsin, and Minnesota were about 6.5 per cent below the eight-years average for those States. The result was the distribution of 40 per cent of the potatoes covered in this study to southern and western points, as indicated in figure 7.

The season 1922–23 found the situation practically reversed. Maine had a crop of only 21,600,000 bushels, which was 13.4 per cent below the eight-years average; New York had a crop 12.7 per cent above the eight-years average; and Michigan, Wisconsin, and Minnesota had crops 41.6 per cent above the eight-years average for those States. The result was the shipment of the bulk of the potatoes covered by this study to eastern destinations, with only a small proportion going to the west and south. A study of table 9 shows the advantage to New York shippers of meeting competition from western States in New York City rather than in Cleveland or in Pittsburgh.

Such shifts in outlets are of serious concern to potato shippers. Wholesale potato merchandising is carried on very largely through the medium of the telephone and the telegraph. In a business of this nature, knowledge of the trade necessarily plays an important rôle and the establishment of reliable trade connections is a long and expensive process. Such violent changes in production as were experienced during these two seasons force the severance of old business ties and the establishment of new and untried market connections which may have little permanent value. Loss and dissatisfaction inevitably result. Such a situation can hardly fail to make the marketing process more expensive and the rendering of efficient marketing services more difficult.

SERVICES RENDERED AT COUNTRY SHIPPING POINTS

The services performed at country shipping points were essentially similar whether the potatoes were sold to a farmers' cooperative association or to a private dealer.

RECEIVING AND LOADING

The potatoes were drawn to the shipping point by wagons or automobile trucks in loads averaging about 50 bushels. They were hauled usually in one of three ways: (1) loose in a deep wagon box with an end gate, from

Figure 9. UNLOADING POTATOES TO GRADERS BY SCOOP-SHOVEL AND FROM CRATES, AT A COOPERATIVE IN WESTERN NEW YORK

At the extreme right of the warehouse the dump equipment is in operation. The photograph shows the special end gate which drops down to make it easy to start shoveling

which they were removed by a scoop or a shovel (figures 9 and 10), (2) in old feed sacks, from which they were dumped directly on the grader (figure 11), or (3) in bushel crates (figure 9). On arrival at the shipping point the wagonload of potatoes was driven on large wagon scales and weighed. The receiver made out a tally slip for each load, giving date, name of farmer, and gross weight of load. The wagonload was then driven to the warehouse, or directly to the freight car in case no warehouses were used, and the potatoes were run over a grader which separated them into grades designated as United States no. 1, United States no. 2, and culls. In the grading operation, the farmer usually shoveled or dumped his potatoes into the hopper of the grader. The potato shipper operated the grader with the help of from two to six men, depending on the size of the grader, whether it was hand- or electrically driven, and what other processes were carried on at the same time. When the potatoes had been run over the grader, the culls were returned to the farmer and the wagon was again driven on the scales and reweighed. The difference between the two weights indicated the number of pounds of graded potatoes

delivered by the farmer. If the shipper bought both United States no. 1 and United States no. 2, the tally slip which the grower received indicated the number of pounds of each delivered. As a general practice, the farmer was paid cash for the potatoes when he wanted it. This phase and the exceptions to this practice are discussed later in connection with each agency.

The shipper sometimes sacked the potatoes directly from the grader, sometimes graded them into bushel baskets and dumped them into a bin, and sometimes graded them into baskets and loaded the car in bulk. If the potatoes were sacked, the sack was next weighed to insure the full weight, and was then sewed carefully with heavy twine. During a busy receiving period the sacks were usually left unsewed until the rush was

FIGURE 10. UNLOADING POTATOES FOR TEMPORARY STORAGE IN BINS AT A SHIPPING POINT IN FRANKLIN COUNTY, WESTERN NEW YORK

over, when all hands turned to sewing. If the potatoes were to be moved at once, and a freight car was ready, the next process was to sweep the car and to line the floor and sides with heavy building paper. In northern New York, cars were usually lined with lumber during cold weather, in addition to paper and sometimes straw. In western New York, refrigerator cars were generally used from November 1 to April 1, and so lumber linings were not necessary. When the car had been prepared by sweeping and lining, the sacks of potatoes were rolled into it by a hand truck and were tiered at the rate of 240 sacks to the car. In the western part of the State, from November 1 to April 1 the car was usually heated by small oil, charcoal, or sheet-iron stoves for from twelve to twenty-four hours before shipping. The stoves were then removed and the car was started toward its destination. With ordinary weather such shipments usually arrived in good condition, but heavy losses were occasionally incurred when the temperature reached low points while the potatoes were en route.

In northern New York, where extremely cold weather is likely to prevail at shipping time, stoves were sometimes fired and left fully charged in the car as it was sent to market. Occasionally a string of potato cars was "messengered," that is, a caretaker accompanied the cars to market in order to keep the fires going so as to prevent the potatoes from freezing.

SELLING

The manager or operator of the shipping agency was, of course, in constant touch with the market. Telegrams and price inquiries were received throughout the day. Careful attention was paid to state and federal market reports giving the prevailing prices, the number of cars shipped to certain markets, and the total movement from each competing area. If the supplies in the markets and the shipments were light, the asking price was advanced and "feelers" were sent out to prospective customers.

A many-station dealer, as soon as the daily price was established, telephoned his buyers at outlying stations informing them as to the price per bushel to offer the growers. There was much competition between different buyers in the same town. The writer has seen five dealers bidding for a single load of potatoes in one of the potato-shipping centers of western New York. Immediate necessity for stock needed to complete a carload sometimes makes it possible for the grower to obtain a premium for his potatoes.

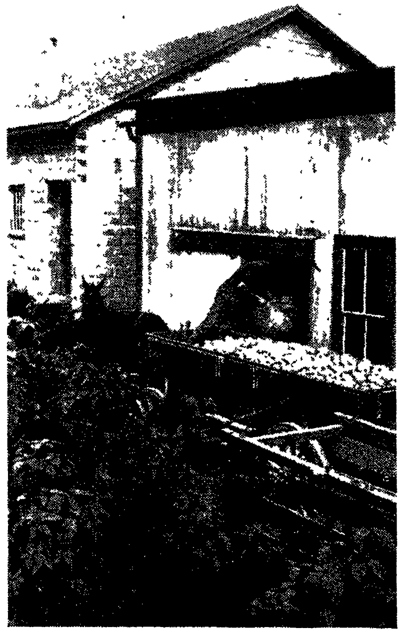


FIGURE 11. UNLOADING POTATOES AT A SHIPPING POINT IN ALLEGANY COUNTY, WESTERN NEW YORK

Potatoes are hauled to the shipping point loose, in bulk, or in sacks. The illustration shows a grower unloading from sacks, but most of the potatoes in this wagon are in bulk

Orders by telegraph or telephone comprised the greater number of sales. Quotations were generally made on sacks or bulk f. o. b. destination on the basis of "freight allowed." This meant that the sight draft which accompanied the bill of sale was made out for the sales price of the potatoes minus the freight, which was actually paid by the receiver.

A large proportion of the carloads were sold through brokers, whose sole purpose was to bring buyer and seller together. The standard broker's fee for this service was $10 per carload of 600 bushels. The broker may have been located at a country point or in one of the large terminal markets. Brokers usually make extensive use of the telephone and the telegraph, and also send out many quotations by mail. They are in constant communication with a large number of markets. Many city wholesale houses

made a practice of ordering all their potatoes through brokers, who were supposed to know the market better than any other agency.

The sale having been made and confirmed, the manager of the shipping agency had the car loaded, sealed, and turned over to the railroad agent, who gave him signed bills of lading therefor. He then drew a sight draft for the sales value of the potatoes in the car, attached it to the original bill of lading, and took it to his local bank where he instructed the banker to forward the draft to a correspondent bank at the destination of the car. On arrival of the draft at its destination, the correspondent bank advised the receiver or purchaser that the draft was there to be taken up. After paying the draft, the purchaser or receiver then obtained the original bills of lading and took possession of the carload. The privilege of examining the car before acceptance, was permitted in many instances. To accomplish this the words "allow examination" were written on the face of the original bill of lading which accompanied the sight draft. When payment of the draft was finally made to the local bank at the shipping point, the bank notified the shipper to that effect and placed the proceeds of the draft, minus a small charge for bank exchange, to the credit of the manager or operator. Payment of drafts was made usually in from ten days to two weeks after shipment. These drafts were in many instances discounted at the local bank by the shipper in order to obtain funds for paying the growers.

Two other methods of selling potatoes were sometimes used, though the foregoing was by far the most common. When potatoes were piling up and sales were not developing readily, a carload was occasionally consigned to a commission merchant in one of the large terminal markets. In such cases, the bill of lading was made out to the merchant, who sold the carload for the best price he could get and remitted the proceeds of the sale to the shipper, minus an agreed percentage as selling commission. Potatoes were not sold on the commission basis unless the markets were dull and the potatoes had to be moved in order to prevent loss from demurrage or other causes.

A few shippers sold by the joint account method. When operating on this basis, the dealer or cooperative bought, loaded, and consigned the carload of potatoes at cost to a joint-account sales agent in one of the large terminal markets. The sales agent then sold the carload as advantageously as possible, often in small lots of a few sacks each. If the potatoes were shipped in bulk, the sales agent sometimes had them sacked at the terminal market in order to meet the requirements of the trade. Any profit over the cost of the potatoes delivered at the terminal market (that is, cost of potatoes loaded at country shipping point, plus freight to destination and cost of sacking at terminal point) was divided between the joint-account sales agent and the country shipper. Losses were likewise shared equally.

GRADES AND GRADING

The necessity for careful grading was recognized and quite generally accepted by growers and shipping agencies alike in the western New York area, and on the average western New York potatoes were well graded during these two seasons. Grading was not popular with the growers in northern New York, and potatoes from that area were not

particularly well graded. Only two grades were in general use — United States no. 1, commonly called "firsts," and United States no. 2, commonly called "seconds." The requirements as established by the United States Department of Agriculture for these grades are set forth in table 10.

TABLE 10. TABULATED COMPARISON OF UNITED STATES POTATO GRADES*

Grade	Minimum diameter (inches)	Tolerance for undersize (per cent)	Tolerance for defects (per cent)	Tolerance for soft rot, decay (included in "Tolerance for defects") (per cent)	Frost injury and decay	Second growth, and growth cracks badly misshapen	Dirt, foreign matter, sunburn, hollow heart, cuts, scab, blight, dry rot, damage by insects or by mechanical means
No. 1.......	$1\frac{7}{8}$ (round) $1\frac{3}{4}$ (long)	5	6	2	Free	Free	Free
No. 2.. ..	$1\frac{1}{2}$	5	6	2	Free	No restrictions	Free from serious damage

* U. S. Agr. Dept. Farmers' bul. 1317 : 15. 1923.

Early in the 1921–22 season, a tally was kept by the writer on 54 loads of potatoes drawn to shipping points in western New York. The proportions in which these loads graded is indicated in table 11. The rejections per load ranged from as low as 20 pounds, or 0.66 per cent, to as high as 480 pounds, or about 14 per cent. On the average, the potatoes in these 54 loads graded as follows: about 89 per cent as United States no. 1, or "firsts," with a range from 74 to 95 per cent for different loads; about 6 per cent as United States no. 2, or "seconds," with a range from 1.4 to 17.9 per cent.

In considering these figures, it should be borne in mind that some sorting and grading takes place in the field while the potatoes are being picked up.

TABLE 11. TOTAL WEIGHTS, NUMBER OF POUNDS, AND PER CENT, OF FIRSTS, SECONDS, AND CULLS, FROM 54 WAGONLOADS OF POTATOES, WESTERN NEW YORK, SEASON 1921–22

Load no.	Pounds of potatoes				Per cent		
	Total weight of load	Firsts, or U. S. no. 1	Seconds, or U. S. no. 2	Rejects, or culls	Firsts, or U. S. no. 1	Seconds, or U. S. no. 2	Rejects, or culls
1...........	3,050	2,790	240	20	91.47	7.87	0.66
2...........	3,280	3,100	120	60	94.51	3.66	1.83
3...........	3,160	2,640	240	280	83.55	7.59	8.86
4...........	3,250	2,690	320	240	82.77	9.85	7.38
5...........	2,550	2,140	320	90	83.92	12.55	3.53
6...........	970	850	80	40	87.63	8.25	4.12
7...........	3,120	2,940	90	90	94.24	2.88	2.88
8...........	3,290	2,990	180	120	90.88	5.47	3.64

TABLE 11 (*concluded*)

Load no.	Pounds of potatoes: Total weight of load	Pounds of potatoes: Firsts, or U. S. no. 1	Pounds of potatoes: Seconds, or U. S. no. 2	Pounds of potatoes: Rejects, or culls	Per cent: Firsts, or U. S. no. 1	Per cent: Seconds, or U. S. no. 2	Per cent: Rejects, or culls
9	2,080	1,930	30	120	92.79	1.44	5.77
10	3,610	3,130	360	120	86.70	9.97	3.33
11	3,560	3,190	190	180	89.61	5.34	5.05
12	3,670	3,230	320	120	88.01	8.72	3.27
13	2,680	2,080	480	120	77.61	17.91	4.48
14	3,230	2,870	300	60	88.85	9.29	1.86
15	3,160	2,620	420	120	82.91	13.29	3.80
16	3,350	2,690	180	480	80.30	5.37	14.33
17	2,750	2,580	150	20	93.82	5.45	0.73
18	3,780	3,570	150	60	94.44	3.97	1.59
19	2,830	2,710	60	60	95.76	2.12	2.12
20	1,920	1,770	120	30	92.19	6.25	1.56
21	3,000	2,700	270	30	90.00	9.00	1.00
22	3,125	3,060	45	20	97.92	1.44	0.64
23	4,510	4,370	110	30	96.90	2.44	0.66
24	2,750	2,180	180	390	79.27	6.55	14.18
25	3,030	2,640	150	240	87.13	4.95	7.92
26	3,890	3,500	60	330	89.97	1.54	8.48
27	2,450	2,300	100	50	93.88	4.08	2.04
28	2,820	2,560	50	210	90.78	1.77	7.45
29	3,570	3,330	120	120	93.28	3.36	3.36
30	3,410	3,200	60	150	93.84	1.76	4.40
31	3,220	2,950	90	180	91.61	2.80	5.59
32	3,220	2,800	320	100	86.96	9.94	3.10
33	2,780	2,500	140	140	89.92	5.04	5.04
34	3,420	2,900	60	460	84.80	1.75	13.45
35	3,090	3,020	50	20	97.73	1.62	0.65
36	3,270	3,000	240	30	91.74	7.34	0.92
37	1,190	950	180	60	79.83	15.13	5.04
38	3,410	3,110	240	60	91.20	7.04	1.76
39	2,680	2,410	150	120	89.92	5.60	4.48
40	3,070	2,680	330	60	87.30	10.75	1.95
41	3,000	2,220	390	390	74.00	13.00	13.00
42	3,270	2,990	190	90	91.44	5.81	2.75
43	2,980	2,460	420	100	82.55	14.09	3.36
44	4,160	3,700	250	210	88.94	6.01	5.05
45	3,540	3,240	60	240	91.53	1.69	6.78
46	3,200	2,850	220	130	89.06	6.88	4.06
47	1,430	1,130	150	150	79.02	10.49	10.49
48	3,540	3,240	60	240	91.53	1.69	6.78
49	2,160	1,870	110	180	86.58	5.09	8.33
50	2,940	2,420	190	330	82.31	6.46	11.23
51	3,370	2,870	80	420	85.16	2.38	12.46
52	1,690	1,340	50	300	79.29	2.96	17.75
53	3,190	2,820	270	100	88.40	8.46	3.14
54	3,990	3,660	180	150	91.73	4.51	3.76
Total	163,655	145,480	9,915	8,260	....	....	......
Average per load	3,031	2,692	184	153	....	....	......
Per cent	100	88.8	6.0	5.2	....	....	......

The foregoing ratios would probably not hold for the total production of potatoes in the areas studied. Undoubtedly many small or diseased tubers are left in the field at harvest time but are probably included in the total crop estimate.

The fact that a large proportion of the potatoes from northern New York were sold by the joint-account method in large terminal markets may be the reason for less attention being given to grading by the northern dealers. The sales agent took what was sent to him, and graded and sacked it to meet his trade requirements; thus objections as to faulty grades did not readily come back on the shipper. With a comparatively high freight rate, however, it seems a doubtful policy to ship poor or undersized stock to any distant market, except in times of great scarcity. Even with the unusually good quality which is characteristic of most northern New York potatoes, it is likely that somewhat better grading would pay. The growers in this section do not seem to appreciate the necessity for grading. This situation, of course, makes it more difficult for dealers or associations, which must meet competition, to improve grading methods.

Good grading seems to be fundamental to efficient commercial handling. It is one of the important factors that determine how the potatoes from one producing area shall meet in the consuming market the competition with the product of other areas.

SACKING AS COMPARED WITH BULK SHIPPING

It was the practice for many years to ship all New York State potatoes in bulk. For the past four or five years, however, there has been a strong tendency toward the use of sacks. The agencies studied during the 1921–22 and 1922–23 seasons used both methods. The percentages of total shipments in sacks and in bulk are shown in table 12:

TABLE 12. BULK AND SACK SHIPMENTS, AND PERCENTAGES OF TOTAL SHIPMENTS, SEASONS 1921–22 AND 1922–23

Type of agency	1921–22				1922–23			
	Pounds shipped		Per cent		Pounds shipped		Per cent	
	Bulk	Sacks	Bulk	Sacks	Bulk	Sacks	Bulk	Sacks
Cooperatives	2,355,730	23,083,785	9.3	90.7	3,223,694	25,000,250	11.4	88.6
Single-station dealers	21,314,703	3,934,080	84.4	15.6	10,823,002	10,654,627	50.4	49 6
Many-station dealers	18,175,388	142,141,937	11.3	88 7	15,597,803	101,353,007	13 3	86.7
Total	41,845,821	169,159,802	19.8	80.2	29,644,499	137,007,884	17.8	82.2

On the average, from 18 to 19 per cent of the up-state potatoes were shipped in bulk during these two seasons. In northern New York, bulk shipments constituted approximately 79 per cent of the total in 1921–22, and 60 per cent in 1922–23 (figures 12 and 13). A higher percentage of potatoes was shipped in bulk by single-station dealers during the first season than during the second season. This was due to the fact that in 1921–22 seven of the eight single-station dealers were located in the northern area, while in 1922–23 five of the single-station dealers were in

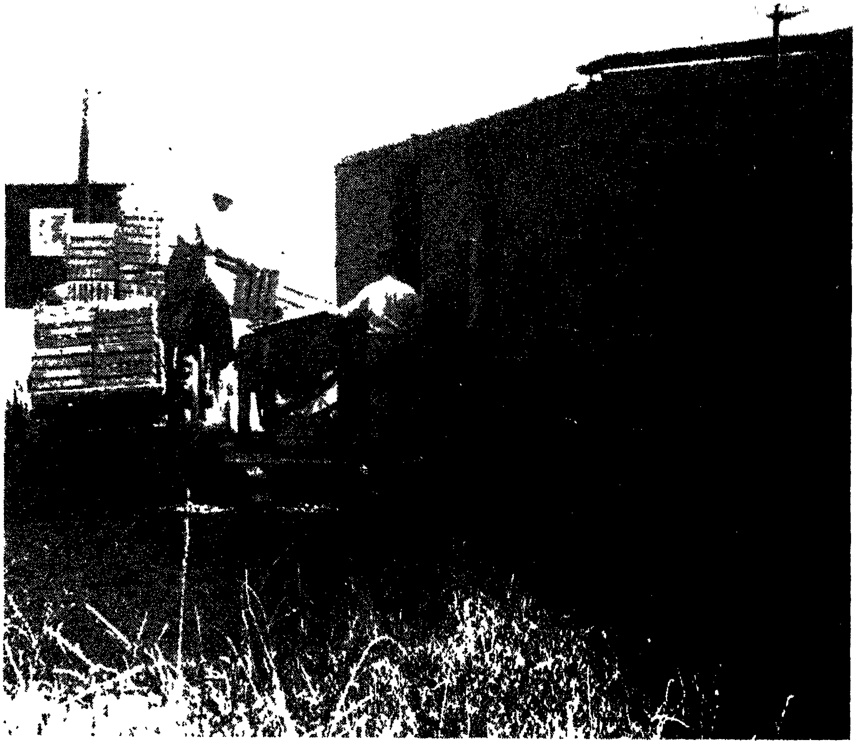


FIGURE 12. GRADING AND LOADING POTATOES IN BULK AT A WESTERN NEW YORK SHIPPING POINT

northern New York and five were in western New York. Bulk shipments in the northern part of the State exceeded sacked shipments by from 10 to 30 per cent. Even when sacks were used there was little or no uniformity as to capacity, type, and so forth. Secondhand feed sacks were often used. They were ordinarily tied with coarse twine and not sewed as is the practice in western New York.

In western New York, the practice of shipping in sacks was very general. During the two seasons, approximately 90 per cent of the potatoes were so shipped. Usually clean, new sacks, holding 150 pounds, or $2\frac{1}{2}$ bushels, were used. In some cases, the sacks were attractively trade-marked (figure 14). All were carefully sewed.

Whether a shipper should ship in bulk or in sacks depends on a variety of factors. Sacking is relatively less important when the shipper has a joint-account sales agent in a large terminal market, for in that case the agent usually prefers to sack the potatoes at the terminal point to meet the fancy of his customers. Sacking is more important when potatoes are sold on the f. o. b. basis, since it is then desirable to know the exact description of the carload of potatoes.

Opinions of potato shippers vary decidedly as to the merits or the demerits of the practice of sacking potatoes. In general, however, the following advantages incident to sacking are recognized:

1. There is less loss or shrinkage in a carload of sacked potatoes than in a bulk carload. One of the main reasons for the adoption of the practice of sacking potatoes was the heavy loss by theft in the terminal markets. This has been very largely eliminated by the use of a sack containing 150 pounds, which is not a very convenient object to steal. Furthermore, potatoes in sacks are easily tallied and the loss is quickly discovered, so that a claim may be made against the carrier if loss has occurred in transit. With the average carload en route from ten days to two weeks, there is always some shrinkage from drying out, and similar causes. This is not serious when the shrinkage is spread through the carload at the rate of $\frac{1}{2}$ or $\frac{1}{4}$ pound per sack of 150 pounds, but the same shrinkage in a carload in bulk will loom up as an actual shortage of a bushel or two.

2. It may be possible to capitalize a trade name on the sack or by use of a tag. This sometimes means a better price, ranging as high as 10 to 15 cents more per sack.

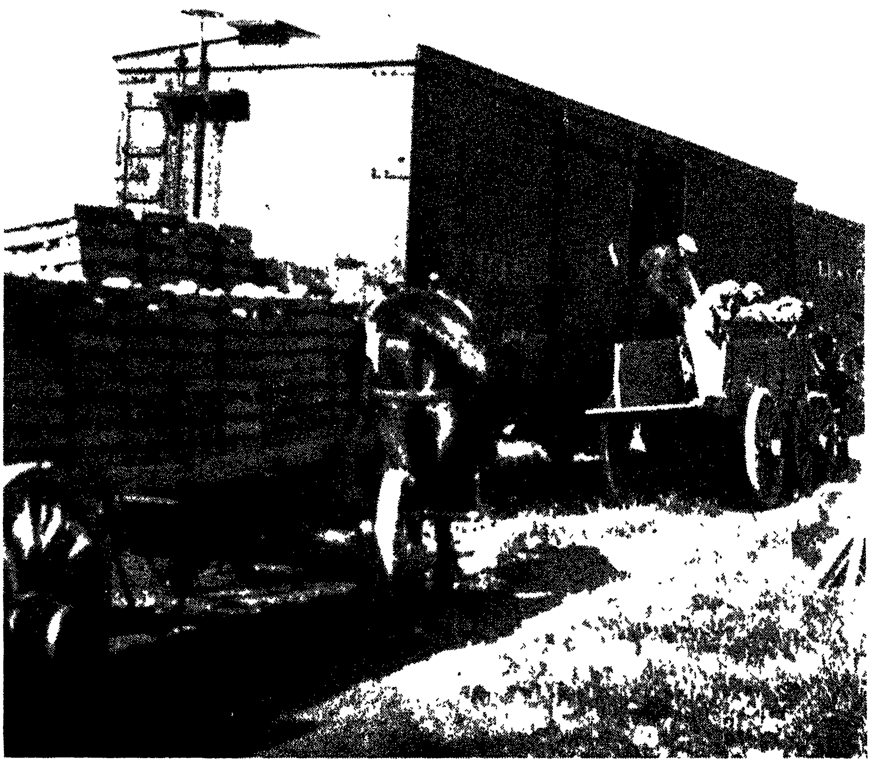


FIGURE 13. GRADING AND LOADING POTATOES IN BULK AT A WESTERN NEW YORK SHIPPING POINT

FIGURE 14. TYPE OF SACK USED, METHOD OF SEWING, AND METHOD OF LOADING POTATOES IN SACKS, AT A SHIPPING POINT IN STEUBEN COUNTY, WESTERN NEW YORK

3. Potatoes must be packaged to haul from the car, and it is cheaper to sack at the country point than in the city, chiefly because of the difference in labor cost. Labor for sacking at the country points costs ordinarily from 30 to 40 cents an hour, while in the terminal markets, where union wage scales are used, the cost of labor runs from 70 cents to $1 an hour. In December, 1923, the index number of wages of farm labor, with board, which is fairly comparable with the labor used in sacking at country points, was 185 on the basis of the index number for 1910–1914 as 100. At the same time, the index number of wages of factory workers in New York State was 220 on the same base.[8]

4. Potatoes in sacks give a neater, more uniform appearance to the whole carload, as contrasted with a carload of potatoes in bulk, in which three or four varieties may be evident from a hasty inspection, as well as a considerable difference in size.

5. Several dealers stated that bulk cars are usually held longer on the track at the terminal market in order to permit the sacking of the potatoes. This is likely to lead to demurrage charges.

6. Some shippers maintain that it is easier to load a car with sacked potatoes. This may be questioned in some places, especially if the car is loaded directly, without the potatoes going through a warehouse.

The disadvantages of sacking potatoes are commonly regarded as follows:

1. Any condition that makes a wet spot on the sack gives the sack a bad appearance. One decayed potato may impair the appearance of a whole sackful. In bulk shipments it is easy to throw out defective potatoes. It is difficult, inconvenient, and expensive to recondition sacked potatoes.

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[8] New York State Coll. Agr., Dept. Agr. Econ. and Farm Mgt. Farm Economics, February, 1924, pages 89 and 100.

2. The buyers in some markets prefer to see the product they are purchasing, and want to sack the potatoes themselves and throw out the poor ones. New York City is such a market. A result of this practice is that bulk potatoes are frequently quoted at higher prices per bushel than sacked potatoes. The price tells only half the tale, however, as the bulk potatoes paid for are those that have been accepted as good potatoes. There may be many bushels sorted out for which nothing at all is paid.

3. The city trade does not yet have full faith in and knowledge of United States grades.

4. There is a slight possibility that the branded sacks of one shipper may be used over again by another shipper who may hurt the trade name. This possibility is not serious, however, in view of the flimsy nature of the original sack, which does not stand refilling well and clearly shows that it is a secondhand sack.

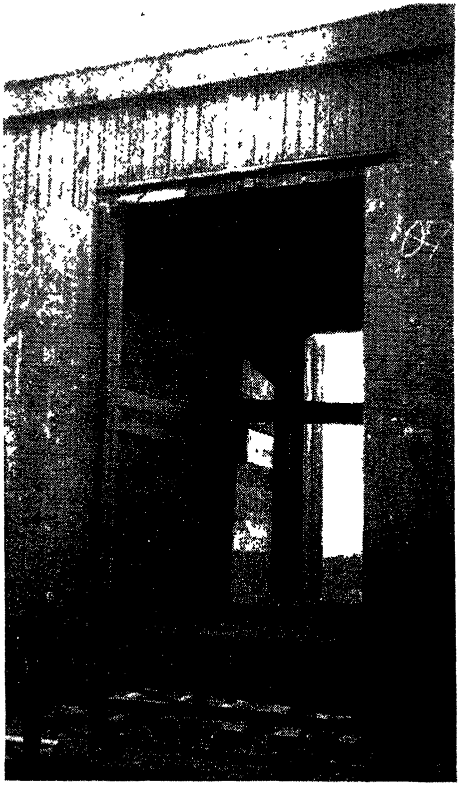

FIGURE 15. BULKHEAD IN A CAR LOADED WITH POTATOES IN BULK AT CHURUBUSCO, CLINTON COUNTY, NEW YORK

5. The cost of sacks and the labor of sacking are considerable items. New sacks generally cost from 9 to 12 cents each, old sacks are commonly bought at approximately 5 cents each. New sacks thus cost about 4 cents per bushel during the two seasons. This cost must be offset by decreased losses from shrinkage or theft, or from increased selling value, if sacking is to be remunerative. The cost of bulkheads (figures 15 and 16) necessary in bulk cars only partly offsets the cost of sacks.

The general tendency toward sacking would seem to indicate that, on the whole, the trade considers that the advantages of sacking outweigh the disadvantages.

WAREHOUSES AND THE STORAGE PROBLEM

Large farmhouse cellars, good roads, and nearness to markets, have been important factors affecting the potato-storage problem in New York. Comparatively large trackside storage warehouses are used in Maine, Wisconsin, and Minnesota. In New York, warehouses are used chiefly for receiving potatoes until enough are accumulated so that a full carload

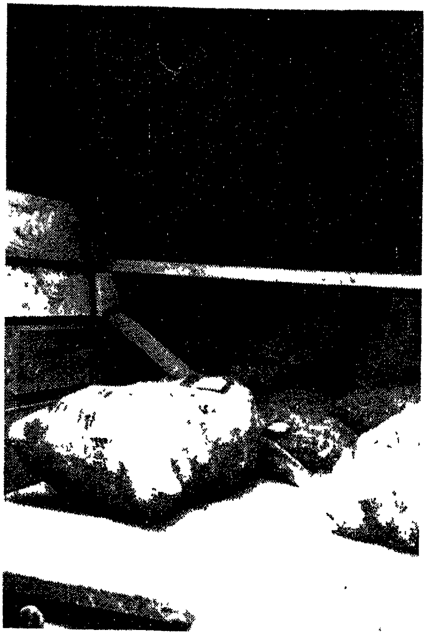

FIGURE 16. BULKHEAD PARTLY CONSTRUCTED IN A CAR BEING LOADED WITH POTATOES IN BULK AT SOUTH WAYLAND, STEUBEN COUNTY, NEW YORK

A few sacks of "seconds" are sometimes thrown into the space between the bulkheads. These are sold for whatever they will bring in the market

or two may be shipped (figures 17 and 18). Potatoes are usually raised within six or eight miles of the nearest shipping point. With an excellent system of state roads, which are kept open throughout the winter to facilitate the hauling of milk as well as the rural free delivery of mail, the problem of transportation of potatoes is not difficult.

The length of the potato-digging season in up-state New York is limited. To protect them from early frosts, the potatoes are brought to the cellars as fast as labor permits. They are often stored temporarily in barns or sheds. Many farmhouses, built when labor and material were cheap, have large, well-protected cellars. The growers who have these cellars find them the cheapest place to store potatoes, but the increased use of modern heating appliances for farmhouses will probably render such cellars less desirable for potato storage. Even then, however, it is likely that potatoes will be stored on the farm rather than at the distant trackside. Labor is at a premium during the digging season, and except on rainy days cannot be used most economically to haul potatoes to the shipping point if any kind of storage is available on the farm. Once the farm-storage space is filled, the remaining potatoes are usually hauled to the shipping point and sold.

TABLE 13. POTATO STOCK IN GROWERS' AND IN DEALERS' HANDS, JANUARY 1*

Year	Per cent held											
	In Maine		In New York		In Michigan		In Wisconsin		In Minnesota		In North Dakota	
	Grower	Dealer	Grower	Dealer	Grower	Dealer	Grower	Dealer	Grower	Dealer	Grower	Dealer
1915–16	82	18	95	5	82	18	78	22	72	28	74	26
1916–17	72	28	85	15	78	22	79	21	62	38	64	36
1917–18	84	16	95	5	88	12	80	20	80	20	86	14
1918–19	81	19	92	8	82	18	80	20	76	24	86	14
1919–20	78	22	90	10	77	23	78	22	76	20	86	14
1920–21	88	12	91	9	83	17	88	12	80	20	62	38
1921–22	81	19	92	8	81	19	74	26	73	27	63	37
1922–23	84	16	92	8	88	12	88	12	74	26	83	17
Average	81	19	92	9	82	18	81	19	75	25	75	25

*U. S. Agr. Dept. Yearbook 1922 : 673–674.

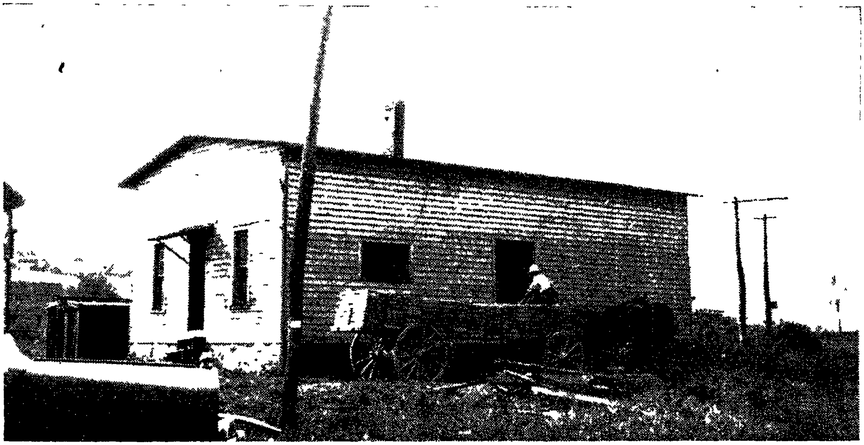

FIGURE 17. POTATO WAREHOUSE RENTED BY A COOPERATIVE AT WEBBS CROSSING, STEUBEN COUNTY, NEW YORK

Occasionally the pit method of storage is resorted to, rather than hauling potatoes a considerable distance when time is so valuable.

This should not necessarily be interpreted to mean that a large part of the crop is stored every year. Financial needs frequently compel the grower to market a large share of his crop as soon as it is dug, and many farmers make it a policy to sell at this time.

In New York the crop is largely held and stored by the grower. The contrast between New York and other States in this respect is seen in a comparison for the past eight years of the reported holdings of potatoes in growers' and in dealers' hands on January 1 (table 13). On the average,

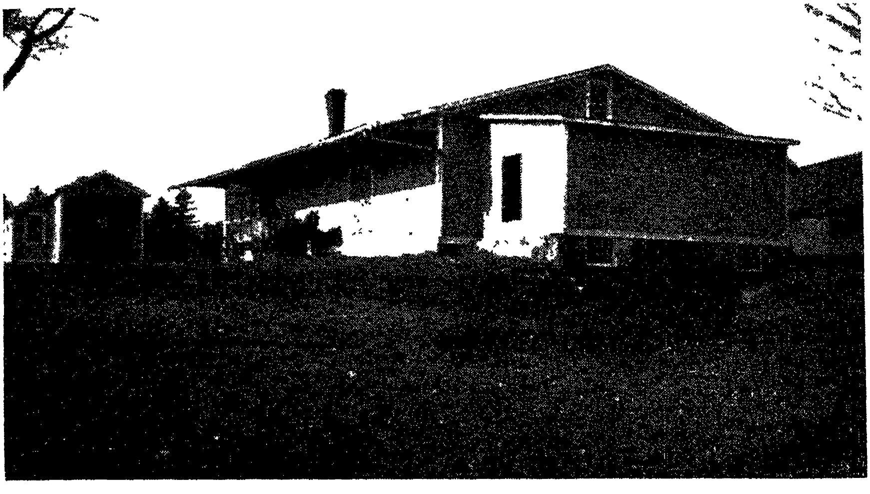

FIGURE 18. COOPERATIVE POTATO WAREHOUSE AT CADYVILLE, CLINTON COUNTY, NEW YORK

FIGURE 19. POTATO WAREHOUSES AT ROGERSVILLE, STEUBEN COUNTY, NEW YORK
The warehouse at the left is used by a cooperative, the others are dealers' warehouses

for that period, dealers have held but 9 per cent of the merchantable potatoes remaining in New York State on January 1, while the corresponding figure for Maine was 19 per cent, for Wisconsin 19 per cent, and for Minnesota 25 per cent.

Potato warehouses at country shipping points in New York vary greatly in size and value (tables 14 and 15, and figures 19 to 22). Of the 24 dealers or associations studied during the 1921–22 season, 23 had warehouses; 1 loaded only at the car door. The average value per warehouse was \$1776, with a range in value from \$300 to \$9500. The investment per 600-bushel carload handled that season averaged \$37.34, ranging from \$6.98 to \$121.79. The 23 shipping agencies had a total of 90 warehouses, and the total permanent storage capacity was estimated by these shippers to be approximately 119,100 bushels. There were actually stored in these warehouses during that season 64,703 bushels, or about two-thirds

FIGURE 20. DEALER'S POTATO WAREHOUSE AT KANONA, STEUBEN COUNTY, NEW YORK

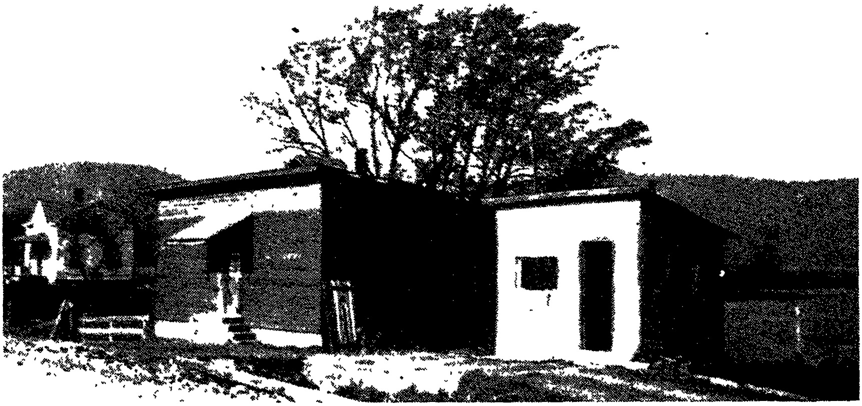

Figure 21. warehouse and scale house of a dealer at kanona, steuben county, new york

of their capacity. These 24 shipping agencies stored approximately 1.3 per cent of the total volume of potatoes shipped by them during the 1921–22 season. (Table 14.)

Of the 34 dealers or associations studied during the 1922–23 season, 33 had warehouses; 1 loaded only at the car door. The average value per warehouse was $1754, with a range in value from $300 to $7500. The investment per 600-bushel carload averaged $46.88, ranging from $11.54 to $162.50. These 33 shipping agencies had a total of 90 warehouses, and the total permanent storage capacity was estimated to be approximately 201,200 bushels. There were actually stored in these warehouses during that season 51,050 bushels, or about 25 per cent of the estimated capacity. These 34 shipping agencies stored approximately 1.8 per cent of the total volume of potatoes shipped by them during the 1922–23 season. (Table 15.)

Figure 22. potato warehouses of two dealers at south wayland, steuben county, new york

Of the 90 warehouses used during the first season, 71 were reported as having no permanent storage space; during the second season, 58 out of the 90 were

TABLE 14. WAREHOUSES: INVESTMENT, PERMANENT STORAGE CAPACITY, AND APPROXIMATE SIZE, 23 POTATO-SHIPPING AGENCIES, SEASON 1921–22

Type of agency	Number of warehouses	Investment at beginning of season: Total	Investment at beginning of season: Per warehouse	Investment at beginning of season: Per 600-bushel carload	Permanent storage capacity of warehouse (bushels)	Number of bushels actually stored for the winter	Number of 600-bushel carloads handled	Approximate size of some warehouses (feet)
Cooperatives	1	$ 5,100 00	$5,100 00	$ 59.30	4,000	3,500	86	50×32
	1	1,000.00*	1,000.00	16 13	600	None	62	20×20
	1	8,621 00	8,621.00	97 97	None	None	88	30×40
	1	2,900 00	2,900 00	25.22	9,000	9,000	115	36×90
	1	9,500.00*	9,500.00	121 79	18,000	15,000	78	72×40
	3	11,075.00	3,691.66	46 92	50,000	21,903	236	20×30; 34×88; 36×50
	1	725.00	725 00	17 68	None	None	41	22×40
Total	9	$38,921.00	....	....	81,600	49,403	706	....
Average	1.3	....	$4,324 56	$55.13	9,067	5,489	78	....
Single-station dealers	1	$2,160.00	$2,160.00	$26.67	1,800	None	81	20×40
	1	300 00*	300.00	6.98	2,000	None	43	20×30
	1	3,500.00	3,500.00	23.18	None	None	151	45×30
	1	1,500 00	1,500.00	14.56	18,000	6,000	103	40×60
	1	2,500.00	2,500.00	62.50	None	None	40	30×50
	1	2,500.00	2,500.00	11.31	3,000	None	221	30×50
	1	1,500.00	1,500.00	33.33	1,200	None	45	18×40
Total	7	$13,960.00	....	....	26,000	6,000	684	....
Average	1	....	$1,994.29	$20.41	3,714	857	98	....
Many-station dealers	6	$10,460.00	$1,743.66	$28.04	None	None	373	....
	1	2,000.00	2,000.00	25 64	7,500	7,500	78	40×30
	8	15,087.62	1,885.95	64.20	None	None	235	....
	21	27,900.00	1,328.57	54.49	None	None	512	....
	2	3,000.00	1,500.00	27.03	None	None	111	30×50; 20×40
	13	23,600.00	1,815.38	36.14	None	None	653	....
	6	2,409.90	401.65	13.77	4,000	1,800	175	....

	9	15,201.84	1,689.09	51 35	None	None	296	....
	8	7,295 52	910.69	15 96	None	None	457	....
Total................	74	$106,954.88	....	....	11,500	9,300	2,890	....
Average..............	8.2	....	$1,445 34	$37.01	155	126	39	....
Total for all agencies.......	90	$159,835 88	....	....	119,100	64,703	4,280	....
Average for all agencies....	......	....	$1,775 95	$37 34	1,323	719	48	....

* Capitalized at ten times annual rental.

TABLE 15. WAREHOUSES: INVESTMENT, PERMANENT STORAGE CAPACITY, AND APPROXIMATE SIZE, 33 POTATO-SHIPPING AGENCIES, SEASON 1922–23

Type of agency	Number of warehouses	Investment at beginning of season			Permanent storage capacity of warehouse (bushels)	Number of bushels actually stored for the winter	Number of 600-bushel carloads handled	Approximate size of some warehouses (feet)
		Total	Per warehouse	Per 600-bushel carload				
Cooperatives	1	$ 4,852.00	$4,852.00	$ 44.93	4,000	1,000	108	50×32
	1	1,000.00*	1,000.00	32.26	600	None	31	20×20
	1	7,096.71	7,096.71	83.49	None	None	85	30×50
	1	2,784.00	2,784.00	20 17	9,000	5,000	138	36×90
	1	7,500.00*	7,500 00	65.79	18,000	18,000	114	72×40
	3	10,635.00	3,211.66	65 65	50,000	6,000	162	20×30; 34×88; 30×50
	1	700 00	700.00	25.00	None	None	28	22×40
	1	1,200.00	1,200.00	63.16	None	None	19	20×30
	1	3,900.00	3,900 00	162 50	6,000	3,000	24	72×30
	2	2,000 00	1,000 00	111.11	5,200	None	18	18×30; 20×30
	1	1,620.00*	1,620.00	37.67	None	None	43	20×30
Total	14	$43,287.71	....	....	92,800	33,000	770	....
Average	1.3	....	$3,091.98	$56.22	6,629	2,357	....	....
Single-station dealers	1	$ 2,000.00	$2,000.00	$21.51	1,800	None	93	20×40
	1	300.00*	300.00	11.54	2,000	None	26	20×30
	1	3,325.00	3,325.00	38.22	None	None	87	45×30
	1	1,350.00	1,350.00	22 50	18,000	18,050	60	40×60
	1	1,425.00	1,425.00	35.63	1,200	None	40	18×40
	1	1,200.00	1,200.00	85.71	3,000	None	14	26×32
	1	2,166.00	2,166.00	69.87	40,000	None	31	136×40
	1	700.00	700.00	18.92	None	None	37	30×50
	1	4,300.00	4,300.00	58.11	7,500	None	74	40×50
	1	2,400.00	2,400.00	18.18	3,000	None	132	30×50
Total	10	$19,166.00	....	....	76,500	18,050	594	....
Average	1	....	$1,916.60	$32.27	7,650	1,805	....	....

Many-station dealers	6	$ 8,000.00	$1,333.33	$34.04	None	None	235	
	1	2,000.00	2,000.00	25.64	7,500	None	78	40×30
	11	15,050 00	1,368.18	83.61	None	None	180	
	2	2,900.00	1,450.00	26 13	11,000	None	111	30×50; 20×40
	12	18,250.50	1,520 87	65.89	None	None	277	
	8	6,452.31	806 54	27.22	4,000	None	237	
	8	11,010.02	1,376.25	84.69	None	None	130	
	5	7,850.00	1,570.00	35 52	None	None	221	
	8	6,605.73	825.72	25.80	None	None	256	
	2	6,000.00	3,000.00	70 59	None	None	85	30×40; 30×80
	1	2,858.40	2,858.40	48.45	4,500	None	59	60×25
	2	8,500.00	4,250 00	62 50	4,900	None	136	24×36; 24×30
Total	66	$95,476.96			31.900		2,005	
Average	6 3		$1,446.62	$47.62	483			
Total for all agencies	90	$157,930.67			201,200	51,050	3,369	
Average for all agencies			$1,754.79	$46 88	2,236	567		

* Capitalized at ten times annual rental.

similarly reported as without permanent storage. The largest storage space reported was for 50,000 bushels; one warehouse had space for 40,000 bushels, although no potatoes were stored in that warehouse; two warehouses had a capacity of 18,000 bushels each; one of 9000; and the remainder reporting permanent storage space each had a capacity of 7500 bushels or less.

Dealers or associations at country points in New York did not carry in storage any appreciable volume of potatoes.

POTATO-HANDLING EQUIPMENT

Two of the shipping agencies were using mechanical dumping equipment with large and specially constructed graders (figures 23 and 24). One of these outfits had a series of automatic conveyors for carrying potatoes into bins or into sacks, as necessity required. These two agencies were, so far as available data show, the only potato shippers in New York using dumping equipment. In each case, this apparatus enabled the grower to remove an entire load of potatoes by gravity and to grade them in approximately one-third of the time taken with a hand grader or one-half the time taken with an electric grader. There was no appreciable saving in the man power needed to operate the dumping equipment as compared with ordinary hand or electric graders, since the larger equipments required more men to operate them. From the point of view of the grower, who frequently has to wait in line for a considerable length of time, these dumping equipments were appreciated. Twenty loads were timed during the fall of 1921 over the three different types of equipment. On the average, the dumping equipment unloaded and graded a 50-bushel wagonload in about 12 minutes, the electric grader in about 25 minutes, and the ordinary hand grader in 40 minutes. These figures represent a very small number of loads, but they may indicate relative efficiencies. The electric graders took 1.5 minutes per man per bushel for unloading, the power dumping outfits 1.75 minutes, and the hand graders 2.18 minutes.

FIGURE 23. PART OF THE DUMPING AND GRADING EQUIPMENT AT A WESTERN NEW YORK SHIPPING POINT

The interior of the building is shown in figure 24

The remainder of the shipping agencies used either hand- or electrically driven graders. A majority of the graders in use were of

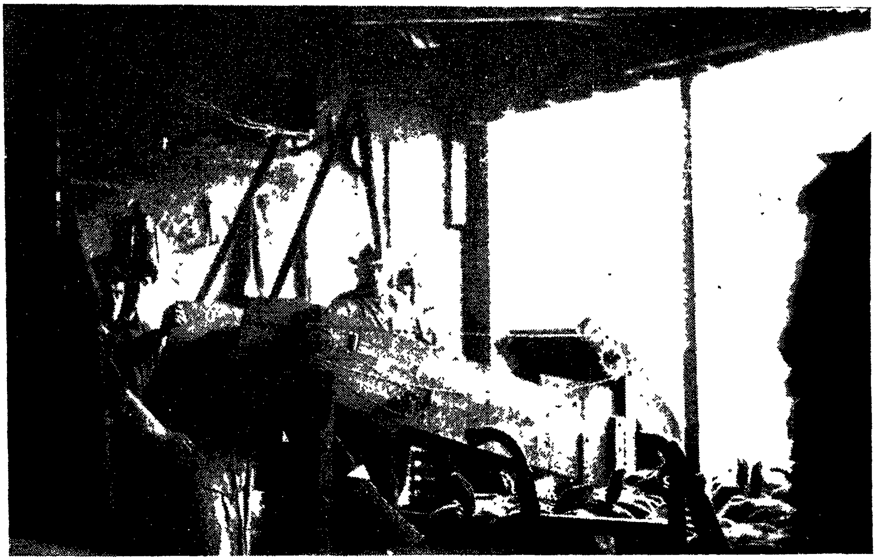

FIGURE 24. DUMPING AND GRADING EQUIPMENT

This is an interior view of the dumping and grading outfit shown in figure 23

the hand-driven type illustrated by figure 25. A price list for March, 1924, gave $60 as the price of this type and size. The heaviest depreciation on these graders was on the mesh belts for grading. These could be replaced at a cost of $18 for the top belt and $15 for the second belt. It was estimated that the average life of a grader was from five to eight years.

A number of these agencies used power-driven graders. These were somewhat more expensive than the hand type. The cost of such a grader in March, 1924, was $250 without the picking table and $278.50 including the table. The depreciation on the power-driven graders was estimated to be somewhat higher than on the hand-driven graders, and varied from 20 to 25 per cent a year. Many of the agencies had both power- and hand-driven graders.

The investment in equipment by the twenty-three agencies studied in 1921–22 varied widely (table 16). The investment in potato-handling equipment per warehouse, on the part of the cooperatives, averaged $326.93, and varied from $83 to $750. The investment in potato-handling equipment per carload handled averaged $4.17 and varied from $1.15 to $13.80.

The single-station dealers had a smaller average investment in equipment per warehouse, $296.93; the variations among individuals was greater, from $51 to $1000. The investment in equipment per carload handled varied from 50 cents to $9.06 and averaged $3.04.

The many-station dealers had the lowest average investment in potato-handling equipment per warehouse, $223.33, but the highest average investment per carload handled, $5.72. This was due to the scattering

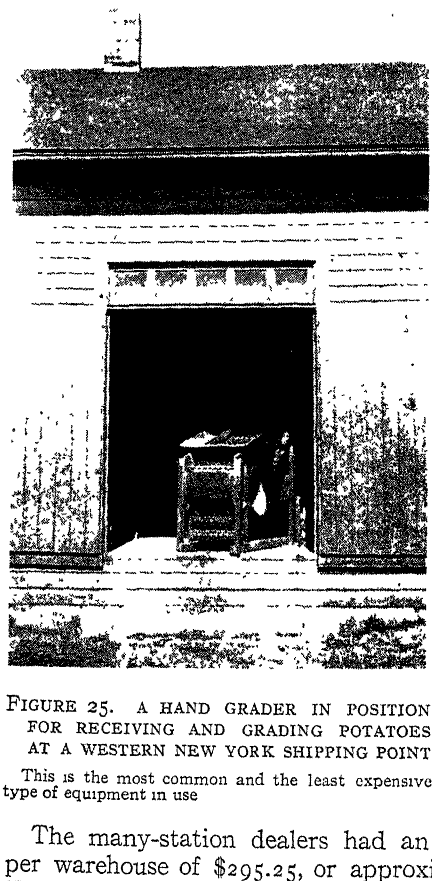

FIGURE 25. A HAND GRADER IN POSITION FOR RECEIVING AND GRADING POTATOES AT A WESTERN NEW YORK SHIPPING POINT

This is the most common and the least expensive type of equipment in use

character of the many-station potato business. The variations in investment per warehouse were from $35 to $395.63. The variations in investment per carload handled in 1921–22 were from 45 cents to $7.27.

The average investment in potato-handling equipment for the twenty-three agencies was $239.42 per warehouse and $5.03 per carload handled.

The investment in equipment per warehouse, during the 1922–23 season, varied with the individual agency and with the type of agency (table 17). The cooperative associations had an average investment in potato-handling equipment of $496.48 per warehouse, or approximately $9.03 per carload handled. The investment per warehouse varied from $73 to $1090, and per carload handled varied from $2.35 to $23.68.

The single-station dealers had an average investment of $268.35 per warehouse, and of $4.52 per carload handled. The investment per warehouse varied from $48 to $925 and per carload handled from 75 cents to $13.19.

The many-station dealers had an average investment in equipment per warehouse of $295.25, or approximately $9.72 per carload handled. The investment in equipment per warehouse varied from $35 to $1059.20, and per carload handled from 45 cents to $23.96.

The average investment in equipment per warehouse for thirty-three agencies during the 1922–23 season was $323.57, with an investment per carload handled of $8.64.

The cooperatives had the highest investment in potato-handling equipment, the many-station dealers had the next highest, and the single-station dealers the lowest. In general, the average investment per carload during 1922–23 was higher than in the previous year because of the smaller volume of potatoes handled.

SIZE OF CARLOADS

The number of pounds shipped per carload varied from 12,000 to 68,895 in 1921–22. The average weight shipped by the many-station dealers was 37,795 pounds, or approximately 630 bushels; by cooperatives, 38,606

TABLE 16. INVESTMENT IN POTATO-HANDLING-EQUIPMENT, 23 SHIPPING AGENCIES, SEASON 1921-22

Type of agency	Investment in potato-handling equipment			Number of 600-bushel carloads handled
	Total	Per warehouse	Per 600-bushel carload	
Cooperatives	$750.00	$750.00	$ 8.72	86
	83.00	83.00	1.34	62
	411.40	411.40	4.68	88
	132.00	132.00	1.15	115
	500.00*	500.00	6.41	78
	500.00	166.66	2.12	236
	566.00	566.00	13.80	41
Total	$2,942 40	. . .	. . . .	706
Average	. .	$326.93	$4.17	. . . .
Single-station dealers	$ 80.00	$ 80.00	$0 99	81
	60.00	60.00	1.40	43
	400 00	400.00	2.65	151
	51.00	51.00	0.50	103
	362.50	362.50	9.06	40
	1,000.00	1,000.00	4.52	221
	125.00	125.00	2.78	45
Total	$2,078.50	. . . . .	. . . . . .	684
Average	. . . .	$296 93	$3.04	. . . .
Many-station dealers	$2,235.65	$372.61	$5.99	373
	35.00	35 00	0.45	78
	1,297.48	162 18	5.52	235
	1,300.00	61.90	2.54	512
	700.00	350.00	6.31	111
	4,600.00	353.84	7.04	653
	1,272.84	212.14	7.27	175
	1,920.53	235 61	6.49	296
	3,165.00	395.63	6.93	457
Total	$16,526.50	. . . . . .	. . . . . .	2,890
Average	. . . .	$223 33	$5 72	. .
Total for all agencies	$21,547.40	. . . .	. . . .	4,280
Average for all agencies	. . . .	$239.42	$5.03	48

* Capitalized at ten times annual rental.

pounds, or approximately 643 bushels; by single-station dealers, 39,771 pounds, or approximately 663 bushels. The average weight per carload for all agencies was 38,688 pounds, or approximately 644 bushels.

The larger carloads shipped by the single-station dealers at this time were probably due to two causes. Several of the single-station dealers sold on the joint-account basis. In such a case, no definite quantity to the carload was specified; the joint-account sales agent took what was sent him and sold it. When sold on any other basis, the number of sacks or bushels was usually specified or understood. Most sales were made on

TABLE 17. INVESTMENT IN POTATO-HANDLING EQUIPMENT, 33 SHIPPING AGENCIES, SEASON 1922–23

Type of agency	Investment in potato-handling equipment: Total	Per warehouse	Per 600-bushel carload	Number of 600-bushel carloads handled
Cooperatives	$ 713.54	$ 713.54	$ 6.61	108
	73.00	73.00	2.35	31
	758.19	758.19	8.92	85
	1,090.00	1,090.00	7.90	138
	500.00*	500.00	4.39	114
	1,962.50	654.16	12.11	162
	531.00	531.00	18.96	28
	450.00	450.00	23.68	19
	370.00	370.00	15.42	24
	215.00	107.50	11.94	18
	287.50	287.50	6.69	43
Total	$6,950.73	....	....	770
Average	....	$496.48	$9.03	....
Single-station dealers	$ 70.00	$ 70.00	$ 0.75	93
	48.00	48.00	1.85	26
	340.00	340.00	3.91	87
	85.00	85.00	1.42	60
	111.50	111.50	2.79	40
	60.00	60.00	4.29	14
	409.00	409.00	13.19	41
	435.00	435.00	11.76	37
	200.00	200.00	2.70	74
	925.00	925.00	7.01	132
Total	$2,683.50	....	....	594
Average	....	$268.35	$4.52	....
Many-station dealers	$2,272.00	$ 378.66	$ 9.67	235
	35.00	35.00	0.45	78
	1,300.00	118.18	7.22	180
	575.00	287.50	5.18	111
	2,139.00	178.25	7.72	277
	1,916.26	239.53	8.09	237
	1,089.48	136.18	8.38	130
	5,296.00	1,059.20	23.96	221
	2,796.50	362.06	10.92	256
	554.00	277.00	6.52	85
	283.39	283.39	4.80	59
	1,230.00	615.00	9.04	136
Total	$19,486.63	....	....	2,005
Average	....	$295.25	$9.72	....
Total for all agencies	$29,120.86	....	....	3,369
Average for all agencies	....	$323.57	$8.64	37

* Capitalized at ten times annual rental.

TABLE 18. FREQUENCY DISTRIBUTION OF WEIGHTS PER CARLOAD FOR 24 SHIPPING AGENCIES, SEASON 1921–22

Range in weight per carload (pounds)	Number of carloads			
	7 cooperatives	8 single-station dealers	9 many-station dealers	Total for 24 shipping agencies
15,000–15,999	.....	.....	4	4
16,000–16,999	.....	1	3	4
17,000–17,999	.....	1	4	5
18,000–18,999	11	.....	7	18
19,000–19,999	1	.....	2	3
20,000–20,999	.....	1	2	3
21,000–21,999	4	.....	2	6
22,000–22,999	1	.....	4	5
23,000–23,999	1	.....	.....	1
24,000–24,999	1	.....	2	3
25,000–25,999	.....	.....	1	1
26,000–26,999	.....	.....	1	1
27,000–27,999	.....	.....	3	3
28,000–28,999	1	1	8	10
29,000–29,999	.....	.....	3	3
30,000–30,999	8	5	203	216
31,000–31,999	2	4	34	40
32,000–32,999	3	5	22	30
33,000–33,999	4	8	65	77
34,000–34,999	6	5	26	37
35,000–35,999	12	9	40	61
36,000–36,999	348	165	2,151	2,664
37,000–37,999	99	74	775	948
38,000–38,999	33	39	144	216
39,000–39,999	36	66	245	347
40,000–40,999	14	55	106	175
41,000–41,999	18	40	71	129
42,000–42,999	32	51	137	220
43,000–43,999	18	30	37	85
44,000–44,999	5	15	21	41
45,000–45,999	26	20	85	131
46,000–46,999	7	12	27	46
47,000–47,999	3	11	17	31
48,000–48,999	2	5	21	28
49,000–49,999	3	3	9	15
50,000–50,999	1	1	5	7
51,000–51,999	3	2	5	10
52,000–52,999	2	3	1	6
53,000–53,999	.....	2	4	6
54,000–54,999	.....	.....	3	3
55,000–55,999	.....	2	6	8
56,000–56,999	1	1	3	5
57,000–57,999	1	.....	1	2
58,000–58,999	1	1	.....	2
59,000–59,999	.....	.....	1	1
60,000–60,999	.....	.....	1	1
61,000–61,999	.....	.....	.....	.....
62,000–62,999	1	.....	1	2
63,000–63,999	.....	.....	1	1
64,000–64,999	.....	.....	.....	.....
65,000–65,999	.....	.....	.....	.....
66,000–66,999	.....	.....	.....	.....
67,000–67,999	.....	.....	1	1
68,000–68,999	1	1	.....	2

the basis of a standard 600-bushel carload. The single-station dealers studied during the 1921-22 season were, with one exception, located in northern New York, where temperatures range low and where greater care must be taken in lining and heating the cars. The larger the number of bushels loaded per car, the lower is the unit cost for heating and lining.

Although the average size of all car-lot shipments was 644 bushels per car, approximately 47 per cent of the 5664 carloads were 600-bushel cars, about 17 per cent were 625-bushel cars, about 6 per cent were 650-bushel cars, 4 per cent were 700-bushel cars, and 4 per cent were 500-bushel cars. The 600-bushel, 36,000-pound, 240-sack carload constituted almost 50 per cent of the total shipments (table 18).

The range in weights of carloads shipped in 1922-23 was from 10,650 pounds to 97,500 pounds. The average weight per carload shipped by the single-station dealers was 37,299 pounds, or 622 bushels; by the many-station dealers, 38,342 pounds, or 639 bushels; by the cooperatives, 38,800 pounds, or 647 bushels. The average weight per carload for all agencies was 38,225 pounds, or approximately 637 bushels, about the same as in the preceding year.

The larger carloads shipped by the cooperatives during this season were probably due to a number of very large carloads of seed potatoes shipped by two cooperatives, as well as to the joint-account method of sale employed by one of these two cooperatives.

The 600-bushel, 36,000-pound, 240-sack carload predominated during the 1922-23 season, as it did during 1921-22 (table 19). Of the total number of carloads, 52 per cent contained 600 bushels, 17 per cent 625 bushels, 5 per cent 650 bushels, about 4 per cent 700 bushels, and 3 per cent 666 bushels.

CLAIMS FOR ALLOWANCES AND DEDUCTIONS

With a very few exceptions, the records kept by these shipping agencies did not indicate the reasons for making allowances or deductions on any particular car, nor was it possible to ascertain from them just how many cars had been rejected. Practically all of the shipping agencies knew the total amount that had been deducted or allowed each season, but none could do much more than venture an opinion as to the reason for such allowances or deductions. Claims and allowances have therefore been computed as a charge per car for the entire volume handled.

These claims arose from a variety of causes. Request for a deduction from the sales price was usually made, after inspection of the car by the receiver at the destination, on the ground that the potatoes were not as specified in the sale. The request for allowance was generally offered as an alternative for complete rejection of the carload by the receiver. The most common causes given by the shippers were: damage by frost; development of disease in transit; below grade; and decline in market price.

Expert graders who had had many years of experience stated that they could not be certain of grading out potatoes that had "hollow-heart," or those that were field-frosted and shipped soon after. Potatoes that have been frosted in the field may not show any evidence of it until they have been allowed to sweat.

TABLE 19. Frequency Distribution of Weights per Carload for 34 Shipping Agencies, Season 1922–23

Range in weight per carload (pounds)	Number of carloads			
	12 cooperatives	10 single-station dealers	12 many-station dealers	Total for 34 shipping agencies
15,000–15,999	5	1	5	11
16,000–16,999	..	1	1	2
17,000–17,999	2	1	1	4
18,000–18,999	2	1	2	5
19,000–19,999	.	...	1	1
20,000–20,999	1	...	1	2
21,000–21,999	1	1	1	3
22,000–22,999	...	1	1	2
23,000–23,999	1	...	2	3
24,000–24,999	.	1	4	5
25,000–25,999	2		2	4
26,000–26,999	1	1	1	3
27,000–27,999	.	.	1	1
28,000–28,999	1	...	4	5
29,000–29,999	...	..	1	1
30,000–30,999	6	3	17	26
31,000–31,999	1	...	5	6
32,000–32,999	2	2	2	6
33,000–33,999	1	4	14	19
34,000–34,999	1	2	28	31
35,000–35,999	10	6	27	43
36,000–36,999	333	284	1,645	2,262
37,000–37,999	75	51	646	772
38,000–38,999	27	26	75	128
39,000–39,999	60	41	132	233
40,000–40,999	36	18	80	134
41,000–41,999	14	15	42	71
42,000–42,999	20	17	129	166
43,000–43,999	8	11	34	53
44,000–44,999	27	10	19	56
45,000–45,999	35	4	88	127
46,000–46,999	7	5	10	22
47,000–47,999	4	3	10	17
48,000–48,999	12	...	18	30
49,000–49,999	10	2	12	24
50,000–50,999	5	1	9	15
51,000–51,999	2	3	9	14
52,000–52,999	5	1	4	10
53,000–53,999	2	1	5	8
54,000–54,999	3	1	3	7
55,000–55,999	...	1	3	4
56,000–56,999	1	...	...	1
57,000–57,999	...	...	2	2
58,000–58,999	1	...	3	4
59,000–59,999	...	...	...	...
60,000–60,999	1	...	1	2
61,000–61,999	1	...	...	1
62,000–62,999	...	...	...	...
63,000–63,999	...	...	1	1
64,000–96,999	...	...	...	...
97,000–97,999	1	...	...	1

Insufficient lining and heating were frequently blamable for the frozen condition of stock when it arrived in the market. Sharp, unseasonable drops in temperature caused heavy losses during both seasons.

Standards of grading varied greatly among these shippers. Many graded their potatoes very carefully; a few were lax, and shipped potatoes as United States no. 1 which were not strictly up to grade. To use their own terms, they "took a chance."

The outstanding reason for claims and allowances, in the opinion of the shippers, was a declining market. When prices were falling, certain types of receivers seized upon any kind of excuse to avoid loss. Defects were discovered in the carload which would pass unnoticed with a rising or a normal market price, and the shipper was notified that the carload would be rejected unless a substantial reduction in price was accepted. In such a situation, the shipper was at a disadvantage. If he refused the request for an allowance, he was likely to have the carload on his hands for several days in a distant market while trying to sell it. Demurrage bills mount rapidly. A rejected car would probably be hard to sell for its real value. A trip to the market to inspect the car might involve an expenditure of time and funds in excess of the amount of the claim. Recourse might have been had to inspection by federal officials, if the potatoes were in a terminal market, and an attempt might have been made to enforce the sale through the courts. Such a procedure would have been lengthy, costly, and probably unsatisfactory. Recognizing the situation at its true value, the shipper usually haggled with the receiver of the potatoes by wire until an allowance was agreed upon. If the receiver demanded too exorbitant an allowance, the shipper often turned the carload over to a commission merchant.

The trade recognizes unjustifiable rejections as a pernicious and harmful practice, but it is a difficult matter to adjust. There are one or two commercial organizations which make a business of settling claims of this sort.

Several shippers are strongly in favor of a licensing system somewhat similar to that used during the World War. They contend that all receivers should be licensed. Then, if a car is rejected and a federal inspector finds the rejection to be unwarranted, the receiver would be given the alternative of accepting the car at the original invoice price or having his license revoked.

An effort has also been made during the seasons of 1922–23 and 1923–24 to prevent the shipment of poor stock. A special shipping-point inspection service was carried on cooperatively in the Steuben County potato area by the New York State Department of Farms and Markets and the United States Department of Agriculture. Using United States potato grades as the standard, a limited number of carloads were inspected and a certificate was furnished describing the carload. The certificate set forth in detail the condition of the car and of the contents at the time of inspection, indicating the percentage of decay, the percentage of other blemishes and defects, and the size of the potatoes, with a final statement as to whether or not the load as a whole conformed to the requirements of United States grade no. 1. Under the provisions of the federal law, the certificate was prima-facie evidence of the truth of the statements

contained therein. Two copies of the certificate were delivered to the shipper; one was for his files, and one was to be attached to the bill of lading. A summarized copy also was placed in each car.[9]

Shipping-point inspection in New York State has as yet been in operation too short a time to warrant definite conclusions as to its efficacy. Opinions of shippers differed as to its value in eliminating rejections. Many of the shippers, particularly the many-station dealers, felt that the inspection was insurance against shipping cars that were off grade. Even with additional federal inspection at the destination, however, some dealers felt that the licensing feature was necessary in order to make the inspection effective.

A movement has likewise been inaugurated among the responsible receivers in the terminal markets. Arbitration committees are being formed to pass on rejections and disputes. Trade associations are being organized for the promotion of higher ethics in the trade. These measures may relieve the situation, but it is doubtful whether rejections can ever be entirely eliminated in dealing with a perishable or semi-perishable commodity such as potatoes.

COSTS AND MARGINS

The gross wholesale price per 600-bushel carload of potatoes, delivered in railroad yards at primary destinations, for all agencies studied during the 1921–22 season averaged $762.53. Freight charges amounted to $107.13, or 14.05 per cent of the gross wholesale price, and $11.05, or 1.45 per cent, was returned as claims and allowances for one reason or another. The grower received, on the average, $566.73, or 74.32 per cent, and the operating costs at the country shipping point averaged $86.57, or 11.35 per cent. The dealers or associations handling potatoes at country points averaged a loss of $8.95 per carload, or 1.17 per cent of the gross sale price. (Figure 26.)

Of the average operating or handling cost of $86.57 per carload at the country shipping point, labor and management constituted $28.64, or 33.08 per cent; warehouse costs, $6.22, or 7.19 per cent; equipment costs, $1.05, or 1.21 per cent; general office costs, $8.35, or 9.65 per cent; telegraph and telephone bills, $3.07, or 3.54 per cent; bank exchange, $1.13, or 1.30 per cent; brokerage and selling commissions, $8.93, or 10.32 per cent; car linings, $2.02, or 2.34 per cent; sacks, tags, and twine, $19.74, or 22.80 per cent; and miscellaneous expenses, $7.42, or 8.57 per cent. (Figure 27.)

Potatoes were more plentiful during the 1922–23 season, and the gross wholesale price for the thirty-four agencies studied averaged $521.57 per carload of 600 bushels, delivered in railroad yards at primary destinations, as compared with $762.53 for the previous year. Freight charges amounted to $98.89, or 18.96 per cent; and $7.29, or 1.4 per cent, was returned as claims and allowances. On the average, the grower received $322.73, or 61.87 per cent of the gross sale price, and the operating costs at the country shipping point averaged $93.67, or 17.96 per cent. The

[9] New York State Dept. of Farms and Markets. Ann. rept. **1922:** 45.

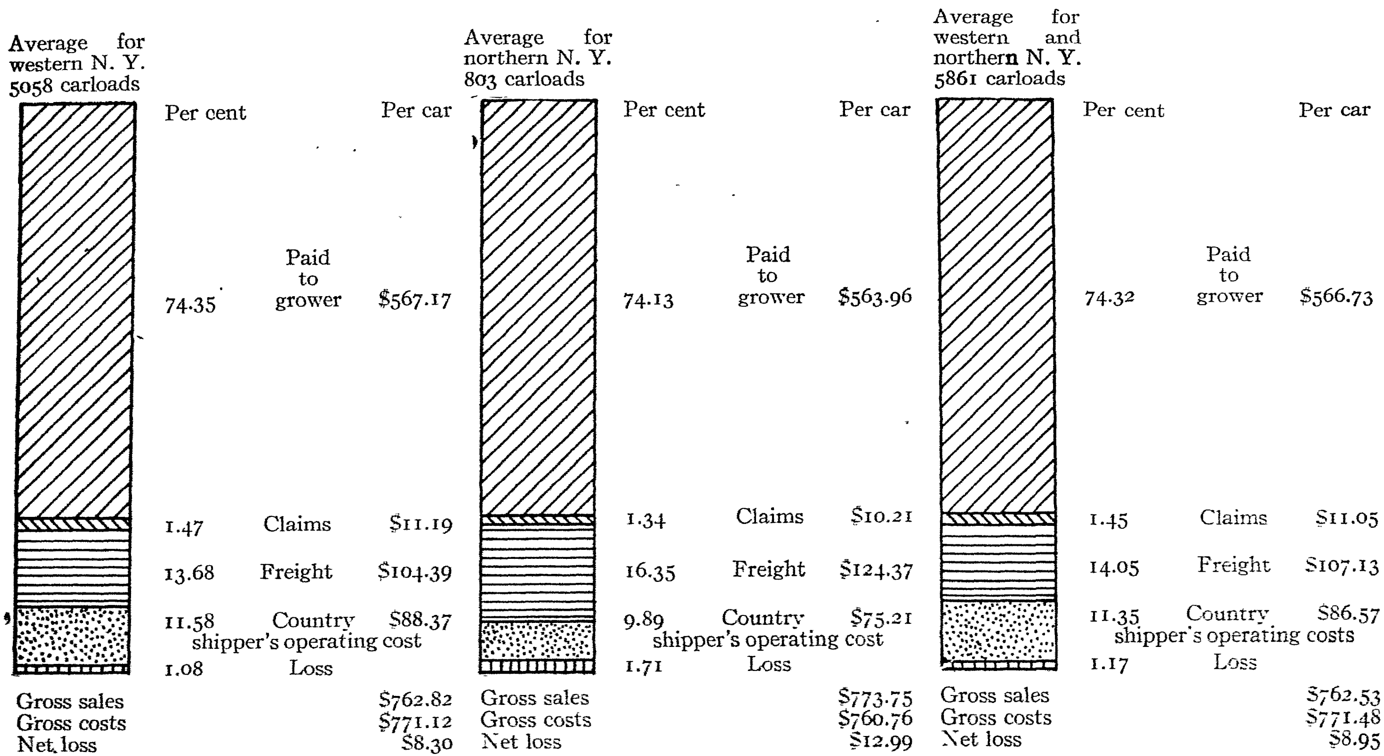

FIGURE 26. DISTRIBUTION OF WHOLESALE PRICE OF POTATOES, 24 SHIPPING AGENCIES, SEASON 1921–22

Data cover 5861 carloads of 600 bushels each. Price is f. o. b. railroad yards at destination

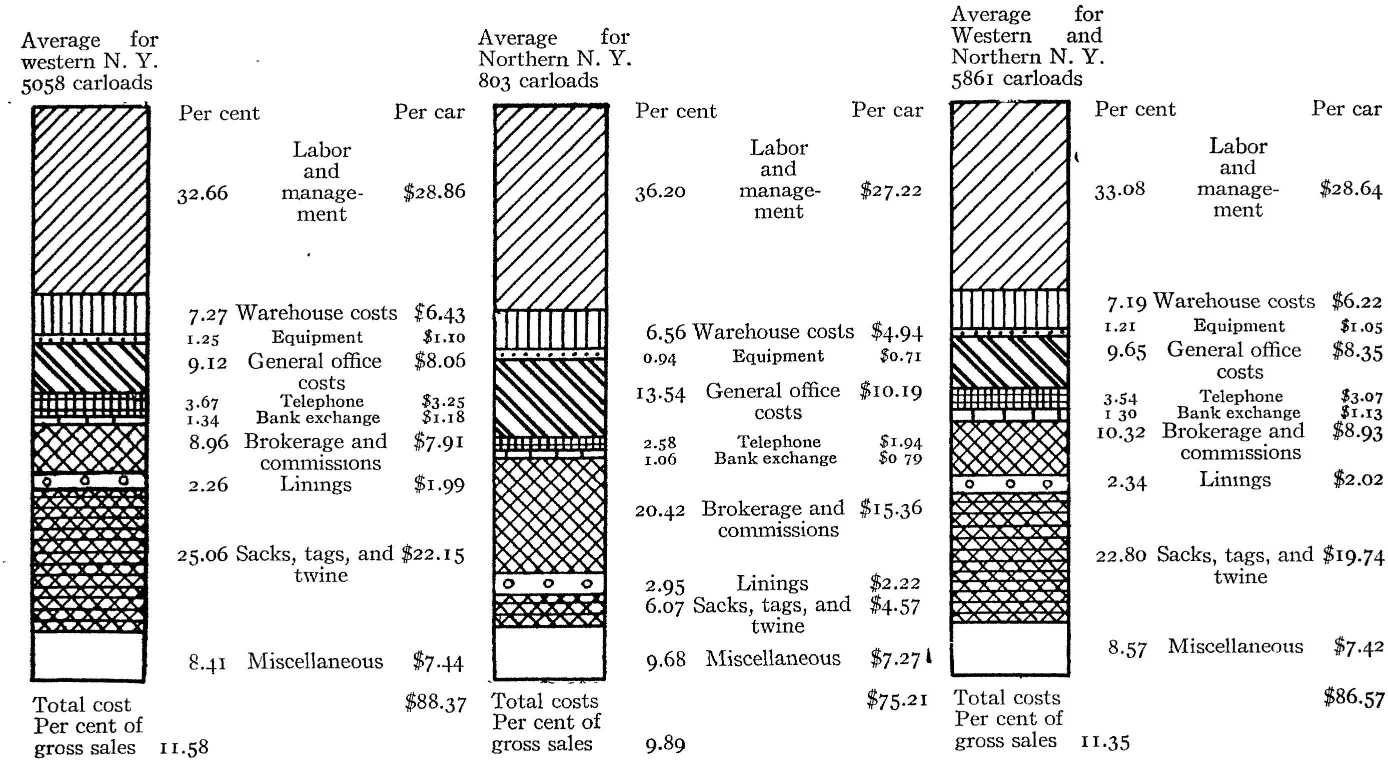

FIGURE 27. DISTRIBUTION OF COSTS OF HANDLING POTATOES AT COUNTRY SHIPPING POINTS, SEASON 1921–22

Data cover 5861 carloads of 600 bushels each. Gross sales price f. o. b. railroad yards at destination

dealers or associations handling potatoes at the country shipping point averaged a loss of $1.01 per carload, or 0.19 per cent of the gross sale price. (Figure 28.)

Of the average total operating or handling costs of $93.67 per carload at the country shipping point, labor and management constituted $28, or 29.88 per cent; warehouse costs, $6.42, or 6.86 per cent; equipment costs, $1.27, or 1.36 per cent; general office costs, $10.27, or 10.97 per cent; telegraph and telephone bills, $2.72, or 2.9 per cent; bank exchange, 84 cents, or 0.9 per cent; brokerage and selling commissions, $11.40, or 12.17 per cent; car linings, $2.06, or 2.2 per cent; sacks, tags and twine, $22.84, or 24.38 per cent; and miscellaneous expenses, $7.85 ,or 8.38 per cent. (Figure 29.)

There were, of course, wide variations in many of these items which will be brought out in the detailed discussions of the three types of shipping agencies.

Estimates have frequently been made as to what proportion of the consumer's dollar the farmer gets. The data in this study cover only wholesale buying prices at the city point, and no data are available to indicate the average retail price of these potatoes. An approximation may be obtained, however, by use of data published by the Bureau of Agricultural Economics, United States Department of Agriculture, giving analyses of the retail prices of potatoes in three large terminal markets - Boston, Chicago, and Pittsburgh.[10] If conditions in the markets receiving New York potatoes were similar to those in Boston and Pittsburgh, then the operating costs, grower's portion, and freight, discussed heretofore, represent approximately from 54 to 58 per cent of the average retail selling price (table 20). This means that New York growers got approximately

TABLE 20. AN ANALYSIS OF RETAIL PRICES OF POTATOES FROM FOUR POTATO-SHIPPING STATES, SEASON 1922–23*

	Maine		Minnesota		Wisconsin		Michigan	
	Per cent of retail price	Price per 100 pounds	Per cent of retail price	Price per 100 pounds	Per cent of retail price	Price per 100 pounds	Per cent of retail price	Price per 100 pounds
Grower's portion...	30.8	$ 0.67	20.6	$0.394	25.7	$0.508	22.6	$0.49
Country buyer's portion..	9.0	0.196	15 7	0 301	16.9	0.333	14.3	0.31
Freight...	18 2	0.395	13 6	0.260	10.4	0.205	17.5	0.38
City distribution ...	42.0	0.912	50 1	0.959	47.0	0.929	45.6	0.99
Average retail price...	100.0	$2.173	100 0	$1.914	100.0	$1.975	100.0	$2.17

* Preliminary report, Bureau of Agr. Econ., U. S. Agr. Dept., p. 3. 1924.

from 35 to 36 per cent of the retail price of potatoes during the 1922–23 season. From 42 per cent to 50.1 per cent of the retail price was absorbed by distribution costs after the potatoes reached the city. Unpublished data gathered cooperatively by the Port of New York Authority and the Bureau of Agricultural Economics, United States Department of Agriculture, for the period from February 2, 1923, to October 26, 1923, indicate that the average wholesale margin in New York City was approximately 5 per cent, the jobber's margin 5 per cent, and the retail margin approximately 35 per cent, of the consumer's dollar. These percentages represent gross margins, not profits.

[10] An analysis of the retail price of potatoes grown in Maine, Minnesota, Wisconsin, and Michigan, and sold in Boston, Chicago, and Pittsburgh. Preliminary report, U. S. Agr. Dept., Bureau of Agricultural Economics. March, 1924.

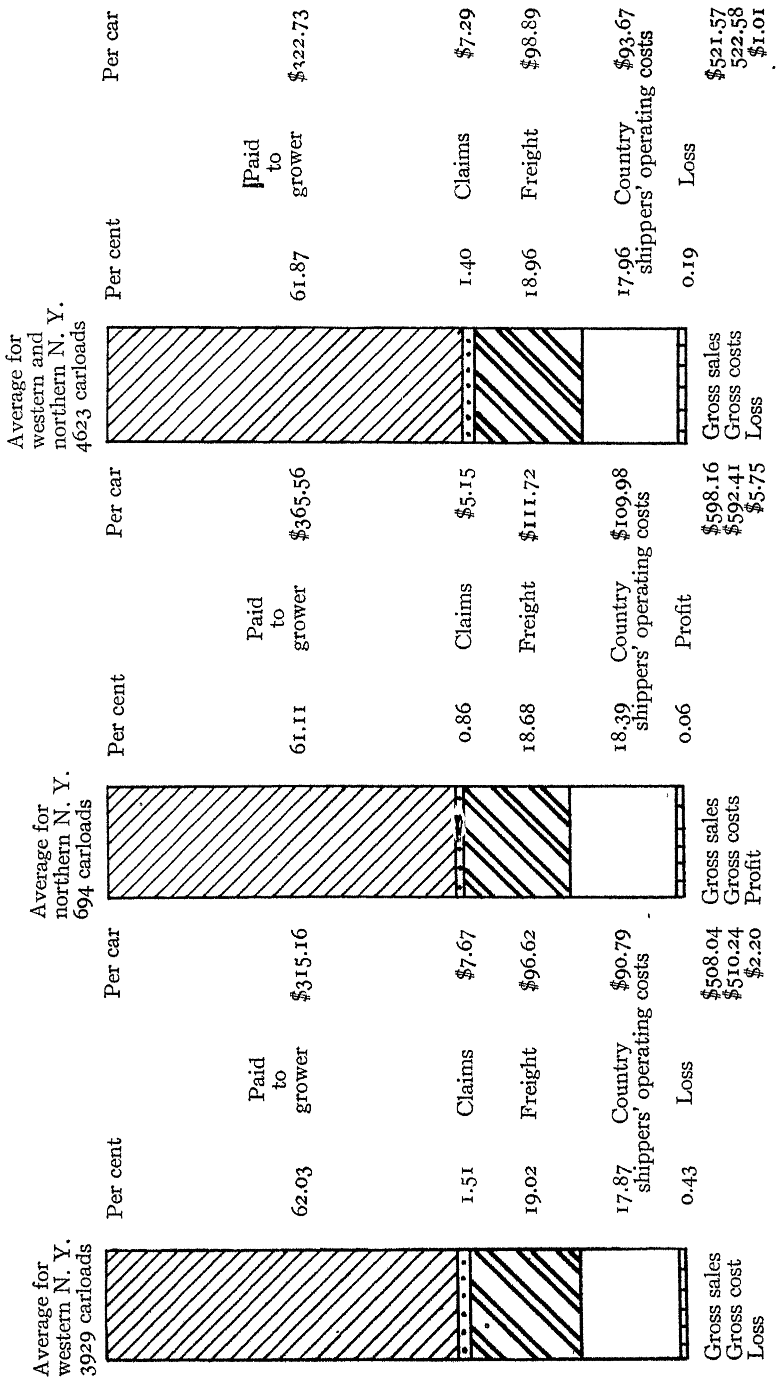

FIGURE 28. DISTRIBUTION OF WHOLESALE PRICE OF POTATOES, 34 SHIPPING AGENCIES, SEASON 1922–23

Data cover 4623 carloads of 600 bushels each. Price is f. o. b railroad yards at destination

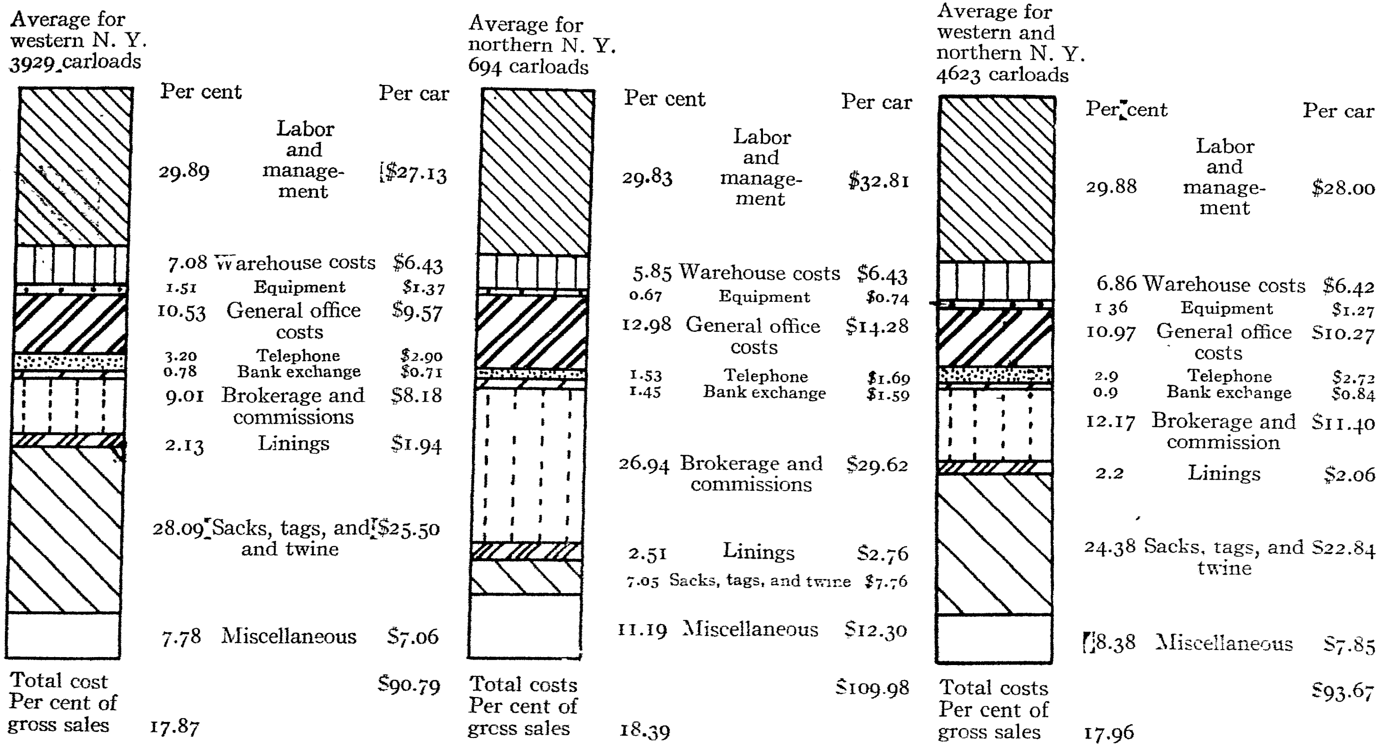

FIGURE 29. DISTRIBUTION OF COSTS OF HANDLING POTATOES AT COUNTRY SHIPPING POINTS, SEASON 1922–23

Date cover 4623 carloads of 600 bushels each. Gross sales price f. o. b. railroad yards at destination

Comparatively little, if anything, can be accomplished by the individual shipper or organization in bringing about reductions in freight rates. Increased returns to the grower will probably have to come about in one or more of three ways: (1) through increasing the gross sale price; (2) through decreasing operating costs at the country shipping point; (3) through decreasing the loss from avoidable claims for allowances and deductions. Something may possibly be done, within rather narrow limits, in the way of increasing sales prices in terminal markets through better knowledge of the trade, advertising, and other ways. However, the keen competition between producing areas will not ordinarily permit great variation in this respect.

The most promising means for increasing the gross sales price for up-state New York potatoes probably lies in the standardization of varieties. This is distinctly a grower's problem. One of the shipping agencies reported that the potatoes shipped during the 1921–22 season were about 30 per cent blue sprouts, 30 per cent white sprouts, 30 per cent russets, and 10 per cent Spaulding Rose. All except the Spaulding Rose, a red variety, were mixed and some of the red potatoes were occasionally found with these.

At least two of the areas with which up-state New York competes, Maine and Long Island, yield a highly standardized product. There is often a marked differential between the price paid per bushel for Maine or Long Island potatoes, and that paid for up-state New York potatoes, in the New York City market. For example, on November 8, 1922, Maine potatoes, 180 pounds in bulk, were quoted at from $2.65 to $2.85; Long Island potatoes, 180 pounds in bulk, were quoted at from $2.85 to $3; while State (meaning up-state) potatoes, 180 pounds in bulk, were quoted at from $2.40 to $2.50. Taking another date at random, January 27, 1923, and the same quantity, 180 pounds in bulk, Maine potatoes were quoted at from $3.15 to $3.40; Long Island potatoes were quoted at from $3.25 to $3.65; while up-state potatoes were quoted at from $2.65 to $2.90.[11] Probably not all of this differential may be ascribed to standardization of variety. Some is undoubtedly due to better quality. The expressed opinion of the trade, however, leaves little doubt that the lack of standardization is a severe handicap encountered by up-state New York potato dealers.

A number of the cooperating agencies were emphatic in stating that the trade discriminated against dark-skinned varieties of potatoes, such as the russets. The objections to this type were that they did not sell well in the table-stock market, and that they were difficult to grade.

Operating costs per standard carload of 600 bushels varied from $51.76 to $156.32. This may indicate that some economies can be brought about at the country shipping point.

The average claims and allowances for the various agencies ranged from 29 cents to $36.35 per carload. Some of these claims may be unavoidable, especially those due to severe drops in temperature or to a sharp decline in the market price. Some of the claims are avoidable, such as those due to lax grading, careless lining of cars, insufficient heating of cars, and selling

[11] The Producers' Price-Current, November 8, 1922, and January 27, 1923.

to unknown or unreliable firms. More careful attention to this phase of the potato business would seem to offer fair promise.

An analysis of the records taken has been made for each type of shipper, with the object of calling attention, if possible, to what seem to be the weak points in the business that may be strengthened.

ANALYSIS OF RECORDS OF THE SHIPPING AGENCIES

FARMERS' COOPERATIVE ASSOCIATIONS

Season 1921–22

The records of seven farmers' cooperative potato-shipping associations were studied for the season 1921-22. For the sake of brevity, the term *cooperative* is used hereinafter in discussing farmers' cooperative associations. All of the cooperatives studied were organized under Article 13-A of the Membership Corporations Law of the State of New York. The date of organization and the length of operation of the cooperatives studied are shown in table 21.

TABLE 21. YEAR OF INCORPORATION, LOCATION, AND LENGTH OF OPERATION, 7 COOPERATIVES ASSOCIATIONS, SEASON 1921-22

Cooperative no.	Year of incorporation	County	Years of operation to June 1, 1922
1	1919	Steuben	3
2	1919	Steuben	3
3	1921	Wyoming	1
4	1919	Steuben	3
5	1921	Clinton	1
6	1919	Steuben	3
7	1919	Steuben	3

None of these cooperatives had been in operation longer than three years. In two cases, the year during which the records were obtained was also the first year of operation. The recent establishment and consequent lack of business experience of these organizations should therefore be borne in mind in interpreting the data which follow.

Volume of potatoes shipped

The seven cooperatives studied in 1921–22 received and shipped 25,439,515 pounds of potatoes, or 423,992 bushels, during that season, equivalent to 706 carloads of 600 bushels each. These potatoes actually moved to market in 670 shipments. Of the total volume, 65 standard carloads, or 9.3 per cent, were shipped in bulk, and 641 standard carloads, or 90.7 per cent, were shipped in sacks. Truck sales amounted to 32,550 pounds, or less than one standard carload. Of the entire amount, 24,342,315 pounds, or 95.69 per cent, were sold as United States no. 1 grade, and 1,097,200 pounds, or 4.31 per cent, were sold as United States no. 2 grade.

The average number of destinations to which the cooperatives shipped their potatoes was 27, and the average number of carloads shipped per destination was slightly less than 4. The destinations, on the average, were scattered over 8 States, and the average number of carloads per State was 13.

These cooperatives handled 12.1 per cent of the volume of potatoes shipped by all the agencies studied, and approximately 5 per cent of all up-state potatoes shipped in carloads during the 1921–22 season.

Primary and group operating costs

The items of expense incurred in the handling and shipping of potatoes by these cooperatives in 1921–22 are given in table 22. There is a wide range in the cost of items in the handling of potatoes at country shipping points.

The primary operating costs are grouped, in subsequent tables, into ten classifications in order to facilitate analysis of the records. The operating costs per 600-bushel carload, grouped into these ten classifications, with additional items bearing on returns, are shown in table 23. A full explanation of the manner of allocating costs is given in the appendix.

Labor and management — Cooperative associations employed two methods in paying for labor and management. Two of the cooperatives paid their managers a flat salary regardless of the volume handled, and paid also for all other labor hired for the work of handling the potatoes. Five of the cooperatives paid their managers on a piece-work basis. The amount paid varied from 8 to 12.6 cents, and averaged 9.5 cents per hundredweight handled (table 24). The managers who loaded on this basis were required to hire, and to pay for from their allowance, any extra labor needed in the handling of the potatoes. Whether a salary or a piece-work method was used depended on local conditions and personalities. The piece-work method was evidently an effort on the part of the cooperatives to insure themselves against paying for the large amount of idle time incident to the irregular hauling of potatoes. The successful carrying-out of such a method calls for good managerial ability and a readily available supply of day labor. Where either is lacking, frequent shifts in managers seem likely to occur. More regular hauling of potatoes — "feeding the market," as it is popularly known — might aid in solving this problem. It is difficult to see how the system can be changed in any other way than by providing a larger volume of potatoes per cooperative. Even then, difficult peaks in hauling will occur. This should be recognized by the members of cooperatives in judging the performance of their managers.

The labor and management cost per carload varied from $17.62 to $34.01, with an average of $27.92 (table 23). The average cost for labor and management per carload during the 1921–22 season, on the 5861 carloads handled by the 24 agencies, was $28.64 (figure 27). This figure might be taken as an indication of what, on the average, the potato shipper felt justified in expending for labor and management per carload handled. While the limitations of an average from so small a number of records is clearly recognized, it is suggested that this figure may serve as a guide.

TABLE 22. PRIMARY OPERATING COSTS PER 600-BUSHEL CARLOAD, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921–22

Cooperative no	1	2	3	4	5	6	7	Weighted averages ‡		
Number of 600-bushel cars	86	62	88	115	78	236	41	Per car	Per bushel	Per hundredweight
Labor	$18.60464	$11.61290	$7.21147	$9.99999	$13.49230	$24.27966	$7.31707	$15.84562	$0.02638	$0.04397
Sacks, tags, and twine	19.23151	19.33500	19.59068	21.63373	10.49666	22.00872	14.63487	19.37305	0.03225	0.05376
Rent for warehouse	0.46512	1.29032	9.78647	...	10.25641	0.18432	1.46341	2.66956	0.00444	0.00740
Taxes on warehouse	0.33953	...	...	0.90756	...	0.75703	0.55756	0.47463	0.00079	0.00131
Insurance:										
Stock	...	...	0.10806	...	0.38461	0.49152	...	0.22026	0.00036	0.00061
Warehouse	0.34884	...	...	0.44999	...	0.45550	0.82756	0.31611	0.00052	0.00087
Employer's liability	0.53721	...	0.18181	...	...	0.35169	...	0.20566	0.00034	0.00057
Fuel	0.29070	...	0.47170	...	1.18884	0.85999	...	0.51303	0.00085	0.00142
Light and power	1.87640	0.96774	0.16681	0.53165	...	1.01118	0.85487	0.80861	0.00134	0.00224
Linings	2.20930	1.61258	0.97363	2.39695	0.50000	2.69618	0.58536	1.91304	0.00318	0.00530
Repairs	2.50511	...	0.12977	0.77808	...	0.63559	...	0.66053	0.00109	0.00183
Supplies	...	0.17371	...	0.41304	...	...	...	0.08253	0.00013	0.00022
Miscellaneous operating expenses	0.29070	...	2.01068	...	0.41974	0.31779	...	0.43864	0.00073	0.00121
Depreciation:										
Warehouse	2.88372	...	...	1.00869	...	1.86440	0.60975	1.17422	0.00195	0.00325
Equipment	0.42395	0.16129	0.93499	0.34782	...	0.31779	0.85365	0.39481	0.00065	0.00109
Officers' salaries	...	...	...	...	...	...	...	...	...	...
Manager's salary	11.37628	29.58081	15.34091	20.76199	30.76923	5.83368	21.43975	15.87221	0.02642	0.04404
Office salaries	...	...	...	0.26956	...	2.90677	0.51463	1.04546	0.00174	0.00290
Travel	0.18512	...	...	0.48695	0.89743	0.21186	...	0.27184	0.00045	0.00075
Office supplies	0.93872	0.21839	0.62874	0.41939	0.59897	0.31779	0.66000	0.49094	0.00081	0.00136
Telephone and telegraph	1.80488	1.69032	1.09238	1.44869	1.07307	1.05533	2.55634	1.36022	0.00226	0.00377
Inspection	0.34884	...	...	...	...	...	...	0.04249	0.00007	0.00011
Office rent	...	0.32258	...	...	...	...	...	0.02832	0.00004	0.00007
Brokerage and commissions	9.94767	4.89677	8.03034	2.78260	35.58282	11.98148	7.31707	11.45731	0.01907	0.03179
Advertising and publicity	...	...	0.64568	...	0.15512	...	...	0.09762	0.00016	0.00027
Market service	...	...	0.02272	...	...	...	...	0.00283	0.000004	0.000007
Interest on borrowed money	0.69767	1.09194	0.17954	...	2.15384	0.95338	...	0.75991	0.00126	0.00210
Interest on investment	4.98639	0.07548	2.21352	2.71252	...	2.93538	2.39951	2.45236	0.00408	0.00680
Miscellaneous office expenses	...	...	...	...	...	...	...	...	...	...
Depreciation on furniture and fixtures	0.31023	...	...	0.13043	...	0.04237	...	0.07320	0.00012	0.00020
Bad debts	...	1.21710	...	...	...	...	...	0.10688	0.00017	0.00029
Demurrage	0.14093	0.86742	0.32261	0.03478	2.30294	0.05673	...	0.41262	0.00068	0.00114
Bank exchange	1.57698	0.39403	0.03374	1.53886	1.16307	1.19999	1.62243	1.10542	0.00184	0.00306
Storage	...	...	0.51499	...	...	...	...	0.06419	0.00010	0.00017
Freight, express, and drayage *	...	2.70581	0.17022	...	0.44230	0.30499	0.23878	0.42352	0.00070	0.00117
Legal expenses	...	...	0.40409	...	...	...	...	0.05036	0.00008	0.00013
Total operating costs	$82.32044	$78.21419	$71.16567	$66.53468†	$111.87735	$84.03111	$64.45261	$80.79131	$0.13453	$0.22422

* This item covers freight and express on sacks, and so forth, and drayage of potatoes to shipping station only. No freight on cars of potatoes is included.
† Cooperative no. 4 let part of a warehouse for $289.65. This amount is deducted from the total cost ($69.05327 − $2.51859 = $66.53468).
‡ Weighted averages per car, per bushel, and per hundredweight are adjusted according to those made for cooperative no. 4.

TABLE 23. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921–22

	Western New York						Average for western New York coop-eratives	Northern New York	Average for western and northern New York cooperatives
Cooperative no.	1	2	3	4	6	7		5	
Number of carloads	86	62	88	115	236	41		78	
Labor and management	$30 52	$32 21	$17.62	$25 57	$29 29	$25 22	$27 17	$34 01	$27 92
Warehouse costs	7 51	1 29	9 79	2 11	6 66	4 50	5.71	8.97	6.07
Equipment costs	3.44	0 32	1.32	0 61	0 43	1 66	1 07	1 28	1 09
General office costs	3.15	10 78	8.60	7 31	5 67	5 44	6.52	13.16	7.26
Telephone and telegraph	1 80	1 69	1 09	1.45	1 06	2 56	1 40	1.07	1.36
Bank exchange	1 57	0 39	0 03	1 54	1 20	1 62	1 10	1.16	1.11
Brokerage and commissions	9 95	4 90	8 03	2 78	11.98	7 32	8 46	35.58	11.46
Linings	2 21	1 61	0.97	2 40	2.70	0 59	2 09	0.50	1.91
Sacks, tags, and twine	19 23	19 34	19.59	21.63	22.01	14 63	20 48	10.50	19.37
Miscellaneous	2.94	5.68	4.12	1 13	3 03	0 91	2 94	5.64	3.24
Total operating costs	$ 82 32	$ 78 21	$ 71 16	$ 66.53	$ 84 03	$ 64 45	$ 76 94	$111.87	$ 80.79
Amount paid to growers	539.15	573 89	576.44	532.70	551.41	562.21	552.73	546.56	552.06
Total cost of potatoes to shipper	$621.47	$652 11	$647.60	$599.23	$635 44	$626 66	$629.67	$658.43	$632.85
Gross sales	$741.71	$766.95	$778.85	$636.64	$782 66	$753 94	$746.35	$760.56	$747 93
Claims and allowances	$ 16 34	$ 1.61	$ 0.85	$ 13.20	$ 12.66	$ 12 39	$ 10 50	$ 1.90	$ 9.55
Freight	106.65	118 96	100.46	.....	116 18	98 24	90 50	122 22	94 01
Net sales	$618.72	$646 38	$677.54	$623.44	$653.81	$643.31	$645.35	$636.44	$644.37
Net profit	....	....	$29.94	$24.21	$18.38	$16 65	$15.68	....	$11.52
Net loss	$2.75	$5.73	....	......	......	..	..	$21 99	....

TABLE 24. BASIS OF PAYMENT FOR LABOR AND MANAGEMENT, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921-22

Cooperative no.	Basis of payment of manager	Source of payment for extra hired labor
1	5 cents per bushel, or 9 cents per hundredweight	Manager
2	7 cents per bushel, or 12.6 cents per hundredweight	Manager
3	Salary $1300 per annum	Cooperative
4	9 cents per hundredweight	Manager
5	Salary $3000 per annum	Cooperative
6	5 cents per bushel, or 9 cents per hundredweight	Manager
7	4.4 cents per bushel, or 8 cents per hundredweight	Manager

Warehouse costs.— The warehouse costs varied from $1.29 to $9.79 per carload handled, with an average of $6.07. This included interest on investment, taxes, repairs, insurance, and depreciation on owned warehouses or rental for rented warehouses. One of the cooperatives owned three warehouses; the remaining six used one each. Two cooperatives rented, and the remaining five owned their warehouses (figures 30 and 31). While not so large an item as that of labor and management, overinvestment in warehouses is relatively more serious. If too high a salary or wage is paid the manager one year, the situation can usually be remedied within a year; but if too expensive a warehouse is built or purchased, the consequences must be borne for many years to come, and are likely to become a very heavy burden in a business where, at best, the margin of profit is small. The average investment of these cooperatives was $4324.56 per warehouse, or $55.13 per carload handled (table 14), which meant an average warehouse cost of slightly more than 1 cent a bushel

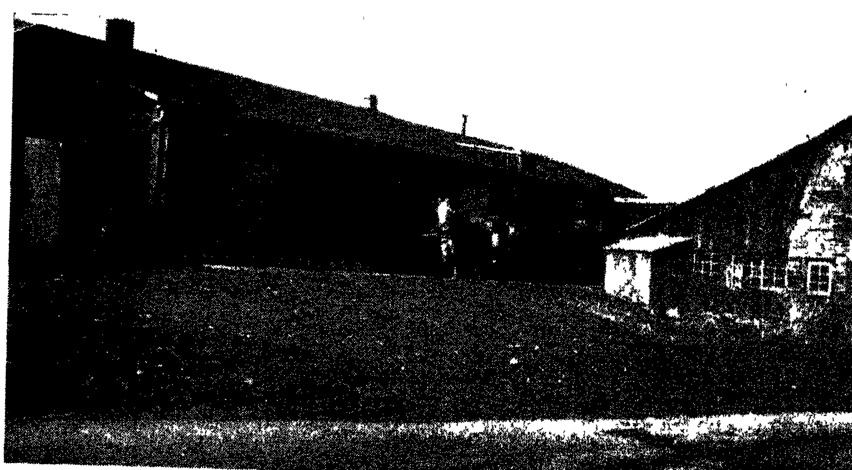

FIGURE 30. COOPERATIVE POTATO WAREHOUSE AT WALLACE, STEUBEN COUNTY, NEW YORK

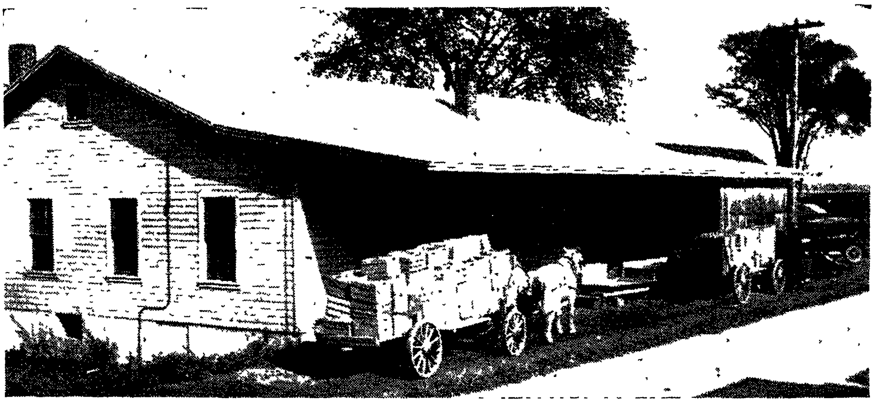

FIGURE 31. COOPERATIVE POTATO WAREHOUSE AT GAINESVILLE, WYOMING COUNTY, NEW YORK

for each bushel handled. The average investment of single-station dealers was \$1994.29 per warehouse, or \$20.41 per carload; and of many-station dealers, \$1445.34 per warehouse, or \$37.01 per carload. It is relatively easy to overinvest in a potato warehouse, and an investment of more than \$50 per carload in this item should not be made without careful consideration.

While some of these cooperatives were evidently bearing a heavy burden from overinvestment in warehouses, others were showing exceptionally good judgment in handling this problem. One was paying \$100 per annum for the rent of a building which could not have been built for less than \$1500 or \$2000, thus obtaining a warehouse at a very low cost. Another paid \$2900 for a brick building which had been erected for other than warehouse purposes and which could not have been built at the time for triple the sum paid for it. Some of the space in this warehouse was rented out, and as a result this cooperative had its warehouse at a very low cost per year.

Equipment costs.— The costs for use of equipment in handling potatoes varied from 32 cents to \$3.44 per carload, with an average of \$1.09. This variation was due largely to the type of grader used — whether hand- or motor-driven. The higher equipment costs per car with motor-driven graders may be offset by a saving in labor.

Brokerage and commissions.— There was a wide range in the amount of brokerage or commissions paid for selling potatoes. The average selling cost per carload was \$11.46, and the range for the different cooperatives was from \$2.78 to \$35.58 per carload. The highest figure, \$35.58 per carload, was due to a different method of selling. This cooperative sold practically all of its potatoes on the joint-account basis, and the \$35.58 represents the pay of the joint-account sales agent in the terminal market.

The higher cost of the joint-account method of selling is due to the fact that the joint-account sales agent performs some of the services of the city jobber. He ordinarily gets a higher price than the broker does, and

therefore his higher charge does not usually mean lower net returns to the country shipper.

The six remaining cooperatives, whose average selling cost was $8.46 per carload, sold most of their potatoes either direct or through brokers, and only at rare intervals consigned a car on commission. The standard brokerage fee per car is $10, and thus it is readily seen (table 23) that some cooperatives sold a large proportion of their potatoes direct.

Sacks, tags, and twine.— The cost per carload for sacks was fairly uniform among all the cooperatives. With the exception of two cooperatives, this cost was about $19 or $20 per car. These two cooperatives, nos. 5 and 7, loaded, respectively, 34 per cent and 65 per cent of their potatoes in bulk, which accounts for the relatively low average cost of sacks per car. Practically the only opportunity for variation in the cost of sacks lay in the purchasing of them in very large quantities, or in the use of secondhand sacks. Neither practice was of any consequence with these cooperatives. It is likely that some saving might be effected by pooling the purchases of sacks and twine for a number of cooperatives.

Total operating costs.— The total average cost of handling a 600-bushel carload of potatoes by these associations was $80.79. The highest cost was $111.87, and the lowest was $64.45. The difference between the highest and the lowest cost was equal to about 8 cents a bushel. The highest cost was due largely to the high selling cost incident to the joint-account method. With cooperative no. 5 omitted, the lowest operating cost was $64.45 and the highest was $84.03, with an average of $76.94.

Amount paid to growers.— A low handling or operating cost did not necessarily mean a high return to the grower. It is possible that a low handling cost which was the result of unwise economy may have resulted in smaller returns to the grower than otherwise would have been the case. If a cooperative sold directly at a price much lower than it could have obtained by utilizing the services of a broker, selling direct might well be regarded as a doubtful practice. If economizing on car linings, which are relatively a small item, resulted in a sizable claim for allowances because of damages, such a practice could hardly be considered economical. In comparing results, then, one would need to know not only the total operating expense, but also the amount of claims and allowances per car, the net sales per car, and the amount paid to the growers.

Two methods of payment were used among the cooperatives — cash when the potatoes were delivered to the warehouse, and cash when the returns for the carload of potatoes had been received. Practice in this respect was about equally divided among the cooperatives. The first method, the setting of a daily price, seemed to give the most satisfaction. The grower wishes to know what he is to receive for his potatoes on the day he hauls them, and dislikes having to wait for ten days or two weeks before receiving his money. Some of the cooperatives plan to meet the latter situation by discounting the drafts and advancing a part of the money to the grower on the day he hauls the potatoes, and the remainder when the returns from the entire car have been received. Advocates of the cash-when-delivered method insist that dealer competition forces them to adopt this method. They claim, furthermore, that it is no more burdensome than the other method, since farmers frequently do not demand an immediate settlement on their weigh slips. By discounting

drafts, they manage to keep enough funds on hand to meet the demands of all growers who actually want payment for their potatoes.

The methods used by some cooperatives to figure the price paid to the grower are shown in the following examples.

Example 1 (season 1921–22):

Selling price of 600-bushel carload, delivered at destination, 240 sacks at $3.35 each		$804.00
Freight	$143.47	
Brokerage	10.00	
Bank exchange	1.65	
Loading, at 5 cents per bushel	30.00	
Sacks, 240 at 10 cents each	24.00	
		$209.12
		$594.88
7 per cent deduction for reserve fund[12]		41.64
		$553 24

$553.24 ÷ 600 (bushels) = $0.92, price per bushel paid to grower.

Example 2 (season 1921–22):

Selling price of 600-bushel carload, f. o. b. shipping point, 240 sacks at $3 each		$720.00
7 per cent reserve fund[13]	$50 40	
Loading, at 5 cents per bushel	30.00	
Sacks, 240 at 9 cents each	21 60	
Brokerage	10 00	
Paper and straw for linings	2.00	$114.00
		$606.00

$606 ÷ 600 (bushels) = $1.01, price per bushel paid to grower.

Example 3[14] (season 1922–23):

Selling price of 700-bushel carload, f. o. b. destination, 280 sacks at $2 each		$560.00
Warehouse fund, 3 cents per bushel	$21.00	
Loading, at 4 cents per bushel	28.00	
Sinking fund, 2 cents per bushel	14.00	
Central selling cost, at 8 cents per hundredweight	33.60	
Freight	135.07	
Sacks, 280 at 12½ cents each	35.00	
		$266.67
		$233.33

$233.33 ÷ 700 (bushels) = $0.33, price per bushel paid to grower.

Comparisons of group operating costs and returns on different bases

Bushel basis.— Growers ordinarily think in terms of bushels rather than of carloads. Operating costs and returns calculated on the bushel basis are given in table 25.

Hundredweight basis.— Studies similar to this are being made in other States, in some of which the practice of buying by the hundredweight is very general. In order that the data from this study may readily be compared with data from the other States, the operating costs and returns calculated on the hundredweight basis are given in table 26.

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[12] The reserve fund was used to pay all operating expenses except those listed, also claims and allowances and payments on mortgage; it serves further as a true reserve fund.

[13] The reserve fund was used also in this case in a manner similar to that set forth in example 1.

[14] The sinking fund and the balance from the warehouse fund were supposed to cover all operating expenses not listed. The central selling cost covered brokerage, bank exchange, claims and allowances not due to carelessness on the part of the cooperative, advertising, and similar expenses.

TABLE 25. GROUP OPERATING COSTS AND RETURNS PER BUSHEL, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921–22

	Western New York						Weighted average for western New York cooperatives	Northern New York	Weighted average for western and northern New York cooperatives
Cooperative no.	1	2	3	4	6	7		5	
Number of bushels	51,592 5	37,242 5	52,605	69,011	14,1726	24,740		47,075	
Labor and management	$0.05086	$0.05361	$0.02947	$0.04260	$0.04877	$0.04179	$0.04525	$0.05633	$0.04649
Warehouse costs	0.01251	0.00214	0.01637	0.00351	0.01108	0.00745	0.00951	0.01486	0.01010
Equipment costs	0.00573	0.00053	0.00220	0.00102	0.00071	0.00274	0.00178	0.00212	0.00182
General office costs	0.00524	0.01794	0.01438	0.01218	0.00944	0.00902	0.01087	0.02181	0.01208
Telephone and telegraph	0.00300	0.00281	0.00182	0.00241	0.00175	0.00423	0.00232	0.00177	0.00226
Bank exchange	0.00262	0.00065	0.00005	0.00256	0.00199	0.00268	0.00182	0.00192	0.00184
Brokerage and commissions	0.01658	0.00815	0.01343	0.00463	0.01995	0.01212	0.01409	0.05895	0.01907
Linings	0.00368	0.00268	0.00162	0.00399	0.00448	0.00097	0.00347	0.00082	0.00318
Sacks, tags, and twine	0.03205	0.03218	0.03277	0.03605	0.03664	0.02425	0.03411	0.01739	0.03225
Miscellaneous	0.00495	0.00951	0.00693	0.00192	0.00511	0.00156	0.00496	0.00940	0.00544
Total operating costs	$0.13722	$0.13020	$0.11904	$0.11087	$0.13992	$0.10681	$0.12818	$0.18537	$0.13453
Amount paid to growers	0.89871	0.95539	0.96428	0.88769	0.91819	0.93170	0.92095	0.90560	0.91924
Total cost of potatoes to shipper	$1.03593	$1.08559	$1.08332	$0.99856	$1.05811	$1.03851	$1.04913	$1.09097	$1.05377
Gross sales	$1.23676	$1.27679	$1.30289	$1.06089	$1.30326	$1.24945	$1.24354	$1.26019	$1.24539
Claims and allowances	$0.02724	$0.00268	$0.00142	$0.02200	$0.02107	$0.02054	$0.01749	$0.00314	$0.01590
Freight	0.17777	1.19803	0.16804	......	0.19347	0.16280	0.15079	0.20250	0.15653
Net sales	$1.03175	$1.07608	$1.13343	$1.03889	$1.08872	$1.06611	$1.07526	$1.05455	$1.07296
Net profit	......	......	$0.05011	$0.04033	$0.03061	$0.02760	$0.02613	......	$0.01919
Net loss	$0.00418	$0.00951	......	......	......	......	......	$0.03642	..

TABLE 26. Group Operating Costs and Returns per Hundredweight, 7 Cooperative Associations, Season 1921–22

	Western New York						Weighted average for western New York cooperatives	Northern New York	Weighted average for western and northern New York cooperatives
Cooperative no.	1	2	3	4	6	7		5	
Number of hundredweights	30,955 5	22,345.5	31,563	41,406 7	85,035 45	14,844 10		28,244 9	
Labor and management	$0 08478	$0.08936	$0.04912	$0 07101	$0 08130	$0 06966	$0 07544	$0 09390	$0 07748
Warehouse costs	0.02086	0.00358	0 02728	0 00585	0 01847	0 01243	0 01585	0 02478	0 01684
Equipment costs	0 00955	0 00089	0 00367	0 00170	0 00119	0 00457	0 00297	0.00354	0 00303
General office costs	0.00874	0 02990	0 02396	0 02030	0 01573	0 01503	0 01811	0 03635	0 02014
Telephone and telegraph	0.00501	0 00468	0.00304	0 00402	0.00292	0.00706	0 00387	0 00296	0 00377
Bank exchange	0.00438	0.00109	0 00009	0 00427	0.00333	0 00448	0 00304	0 00321	0.00306
Brokerage and commissions	0 02763	0 01358	0.02238	0 00772	0 03325	0.02021	0 02349	0 09826	0 03179
Linings	0 00613	0.00447	0 00271	0 00665	0 00748	0.00161	0 00579	0 00138	0.00530
Sacks, tags, and twine	0 05342	0.05364	0.05462	0 06008	0 06108	0 04042	0.05685	0.02898	0 05376
Miscellaneous	0.00815	0 01582	0 01154	0 00318	0 00845	0 00256	0 00823	0 01553	0 00906
Total operating costs	$0 22865	$0 21701	$0 19841	$0 18478	$0 23320	$0 17803	$0 21364	$0 30889	$0 22423
Amount paid to growers	1 49785	1.59232	1.60715	1 47947	1 53030	1 55283	1 53490	1 50935	1 53206
Total cost of potatoes to shipper	$1.72650	$1.80933	$1 80556	$1 66425	$1 76350	$1 73086	$1 74854	$1 81824	$1 75629
Gross sales	$2 06060	$2 12799	$2 17150	$1.76816	$2.17213	$2 08240	$2 07256	$2 10033	$2.07565
Claims and allowances	$0.04540	$0 00447	$0.00237	$0.03666	$0 03513	$0 03423	$0.02916	$0.00523	$0 02650
Freight	0 29629	0 33006	0 28008	...	0.32245	0 27134	0 25131	0 33751	0.26088
Net sales	$1 71891	$1 79346	$1 88905	$1 73150	$1 81455	$1 77683	$1 79209	$1.75759	$1.78827
Net profit	...	...	$0 08349	$0 06725	$0 05105	$0 04597	$0 04355	...	$0 03198
Net loss	$0 00759	$0.01587	...	...	...	...	...	$0 06065	...

As percentages of total operating costs.— The proportion which the items of operating costs were of the total operating costs varied considerably. Labor and management varied from about 25 per cent to about 41 per cent of the total operating costs, with an average of about 35 per cent (table 27); warehouse costs ran from less than 2 per cent to about 14 per cent, with an average of 7.51 per cent; equipment costs varied within wide

TABLE 27. GROUP OPERATING COSTS AS PERCENTAGES OF TOTAL OPERATING COSTS, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921–22.

	Western New York						Average for western New York coopera-tives (per cent)	Northern New York	Average for western and northern New York coopera-tives (per cent)
Cooperative no. . .	1	2	3	4	6	7		5	
Groups	Per cent							Per cent	
Labor and management.	37.07	41.19	24.76	38.43	34.87	39.13	35.31	30.40	34.56
Warehouse costs. .	9.12	1.65	13.75	3.17	7.92	6.98	7.42	8.02	7.51
Equipment costs. .	4.18	0.41	1.85	0.92	0.51	2.57	1.39	1.15	1.35
General office costs.	3.82	13.78	12.08	10.99	6.75	8.45	8.48	11.77	8.98
Telephone and telegraph. . . .	2.19	2.16	1.53	2.18	1.25	3.97	1.81	0.96	1.68
Bank exchange. . .	1.92	0.50	0.05	2.31	1.43	2.52	1.43	1.04	1.37
Brokerage and commissions. . .	12.09	6.26	11.28	4.18	14.26	11.35	11.00	31.81	14.18
Linings.	2.68	2.06	1.37	3.60	3.21	0.91	2.72	0.44	2.37
Sacks, tags, and twine.	23.36	24.72	27.53	32.52	26.19	22.71	26.61	9.38	23.98
Miscellaneous. . . .	3.57	7.27	5.80	1.70	3.61	1.41	3.83	5.03	4.02

limits, as did brokerage and commissions, and linings; labor and management, and sacks, tags, and twine, together constituted, on the average, 58.54 per cent of the total operating costs, and these items combined with brokerage and commissions amounted, on the average, to 72.72 per cent of the total operating costs.

As percentages of net sales.— A method of analysis frequently used by commercial concerns is that of expressing costs on the basis of percentage of net sales. Costs for the seven cooperatives calculated on this basis are given in table 28. For every $100 of net sales (gross sales minus claims, allowances, and freight), an average of $4.33 was paid for labor and management, 94 cents for warehouse costs, 17 cents for equipment costs, $1.13 for general office expenses, 21 cents for telephone and telegraph, 17 cents for bank exchange, $1.78 for brokerage and commissions, 30 cents for car linings, $3.01 for sacks, tags, and twine, and 50 cents for miscellaneous expenses. The total operating costs thus constituted, on the average, $12.54 out of each $100 of net sales. Claims and allowances averaged $1.48 for each $100 of net sales. There were, of course, wide variations in these percentages among the different cooperatives studied.

Score cards showing relative standing in efficiency.— In order to furnish an easy basis of comparison, score cards showing the relative standing in efficiency on operating costs and claims for allowances (table 29) and on returns (table 30) were calculated for these seven cooperatives. It was assumed that a cooperative or any other agency must be at least as good as the average, to be efficient. The average items of group cost for the

TABLE 28. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921–22

	Western New York						Average for western New York cooperatives (per cent)	Northern New York	Average for western and northern New York cooperatives (per cent)
Cooperative no.	1	2	3	4	6	7		5	
Groups	Per cent							Per cent	
Labor and management...	4.93	4.98	3.60	4.10	4.48	3.92	4.21	5.34	4.33
Warehouse costs..	1.21	0.20	1.45	0.34	1.02	0.70	0.88	1.41	0.94
Equipment costs..	0.56	0.05	0.19	0.10	0.07	0.26	0.17	0.20	0.17
General office costs..	0.51	1.67	1.27	1.17	0.87	0.85	1.01	2.07	1.13
Telephone and telegraph .	0.29	0.26	0.16	0.23	0.16	0.40	0.22	0.17	0.21
Bank exchange .	0.25	0.06	....	0.25	0.18	0.25	0.17	0.18	0.17
Brokerage and commissions	1.61	0.76	1.19	0.45	1.83	1.14	1.31	5.59	1.78
Linings ..	0.36	0.25	0.14	0.38	0.41	0.09	0.32	0.08	0.30
Sacks, tags, and twine.. . ..	3.11	2.99	2.89	3.47	3.37	2.27	3.17	1.65	3.01
Miscellaneous . .	0.47	0.88	0.61	0.18	0.46	0.14	0.46	0.89	0.50
Total operating costs ..	13.30	12.10	11.50	10.67	12.85	10.02	11.92	17.58	12.54
Claims and allowances...	2.64	0.25	0.13	2.12	1.94	1.93	1.63	0.30	1.48

TABLE 29. SCORE CARD OF OPERATING COSTS, AND CLAIMS AND ALLOWANCES, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921–22*

Cooperative no....	1	2	3	4	5	6	7
Groups	Per cent of average						
Labor and management..	107	112	62	89	119	102	88
Warehouse costs..	121	21	157	34	144	107	72
Equipment costs...	328	30	126	58	122	41	158
General office costs.	38	129	103	88	158	68	65
Telephone and telegraph	59	55	36	47	35	35	83
Brokerage and commissions........	111	55	90	31	398	134	82
Linings...........	109	80	48	119	25	134	29
Sacks, tags, and twine...........	97	98	99	110	53	111	74
Miscellaneous.....	40	77	56	15	76	41	12
Claims and allowances...........	148	15	8	119	17	115	112
Total score....	1,158	672	785	710	1,147	888	775

* The lowest score is the most efficient. Average = 1000.

twenty-four agencies were taken as 100 per cent, and each group cost and the returns of each cooperative were scored on the basis of the percentage of the average for that item. This resulted in weighting the factors to a degree. This method of comparison is not ideal, but it furnishes an approximate basis of comparison for those who desire such a basis.

Total scores give a rough approximation of relative efficiency, but they should not be taken too literally. For example, the most important single reason for the high total score of cooperative no. 5 was the joint-account basis of selling, with the consequent high costs of selling. This is not a weakness, but it should be considered in conjunction with returns. Relatively low costs for linings may be unwise economy. The best use of these score cards lies in the comparison of individual items.

It appears from the score card for costs (table 29) that cooperative no. 2 was, on the whole, the most efficient. But its business organization was not perfect. Its labor and management costs and general office costs were considerably above the average. Cooperative no. 4 ranked close to no. 2 in cost efficiency, but its costs for linings and sacks were above the average, and claims and allowances were high.

In analyzing the score card for returns (table 30), it appears that cooperative no. 3 was the most efficient in this respect. Cooperative no. 2 held fourth rank. It should be noted that the cooperative which has the higher efficiency in costs is not necessarily the one which has the higher efficiency in returns. For example, cooperative no. 4 ranked second in efficiency in costs, but fifth in efficiency in returns.

TABLE 30. SCORE CARD OF RETURNS, 7 COOPERATIVE ASSOCIATIONS, SEASON 1921–22*

Cooperative no.	1	2	3	4	5	6	7
Items	Per cent of average						
Amount paid to growers, plus net profit or minus net loss	95	100	107	98	93	101	102
Net sales	96	100	105	97	99	101	100
Total score	191	200	212	195	192	202	202

* The highest score is the most efficient. Average = 200.

Season 1922–23

During the 1922–23 season, the records of twelve farmers' cooperative shipping associations were studied including the seven studied during the previous season. All twelve cooperatives were organized under Article 13-A of the Membership Corporations Law of the State of New York. The date of organization and the length of operation of each cooperative are shown in table 31.

At the time when these data were obtained, six of these cooperatives had been in operation for four years and four of them for two years, and two had just completed their first year of operation. All were relatively young in a business sense, although several had managers experienced in handling and shipping potatoes. Cooperatives nos. 101 to 106, inclusive, were of the independent type, that is, they were not affiliated with any other organization. These cooperatives sold their product either directly or through brokers or commission men. Cooperatives nos. 107 to 112, inclusive, were affiliated with the Empire State Potato Growers' Coopera-

TABLE 31. YEAR OF INCORPORATION, LOCATION, AND LENGTH OF OPERATION, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

Cooperative no.	Year of incorporation	County	Years of operation to June 1, 1923
101	1919	Steuben	4
102	1919	Steuben	4
103	1921	Wyoming	2
104	1919	Steuben	4
105	1921	Clinton	2
106	1919	Steuben	4
107	1919	Steuben	4
108	1921	Clinton	2
109	1919	Steuben	4
110	1921	Steuben	2
111	1922	Allegany	1
112	1922	Allegany	1

tive Association, Inc., a central selling organization. These cooperatives bought and loaded the potatoes, and then turned them over to the central selling agency for sale at an agreed commission of 8 cents a hundredweight. This fee was intended to cover brokerage, bank exchange, claims and allowances not due to carelessness on the part of the local cooperative, advertising of the Empire State brand of potatoes, and general organization expenses. The central agency also supplied market news service to its members, and assisted in establishing grading practices.

Volume of potatoes shipped

The twelve cooperatives received and shipped 28,223,944 pounds of potatoes, or 486,906 bushels, during the 1922–23 season, equivalent to 781 carloads of 600 bushels each. These potatoes actually moved to market in 751 shipments. Of the total volume, 87 standard carloads, or about 11 per cent, were shipped in bulk, and 694 standard carloads, or about 89 per cent, were shipped in sacks. Truck sales amounted to 134,550 pounds, or slightly less than four standard carloads.

Of the total volume, 27,752,874 pounds, or 98.33 per cent, were sold as United States no. 1 grade, and 471,070 pounds, or 1.67 per cent, were sold as United States no. 2 grade.

The average number of destinations to which the cooperatives shipped their potatoes was 20, and the average number of carloads shipped per destination was slightly more than 3. The destinations, on the average, were scattered over 5 States, and the average number of carloads per State was 13.5. The older independent cooperatives reached an average of 6 States; the affiliated cooperatives reached an average of 4 States.

These twelve cooperatives handled 17 per cent of the volume of potatoes shipped by all the agencies studied, and approximately 6.5 per cent of all up-state potatoes shipped in carloads during the 1922–23 season.

Primary and group operating costs

The items of expense incurred in the handling and shipping of potatoes by these cooperatives in 1922–23 are given in table 32. Cooperative no.

TABLE 32. PRIMARY OPERATING COSTS PER 600-BUSHEL CARLOAD, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

Cooperative no.	101	102	103	104	105	106	107	108	109	110	111	112	Weighted averages§		
Number of 600-bushel cars	108	31	85	138	114	162	28	19	24	18	43	10	Per car	Per bushel	Per hundred-weight
Labor	$16.78222	$23.22580	$11.95647	$14.49275	$24.14184	$23.18574	$21.42857	$34.25105	$10.03125	$12.85833	$12.20186	$16.24500	$18.54761	$1.03085	$0.05125
Sacks, tags, and twine	25.38231	22.18871	26.97035	31.28985	11.97868	31.04963	28.80607	20.76210	27.51833	25.32611	28.83627	40.53900	26.15119	0.04350	0.07227
Rent for warehouse	0.74185	2.58064	0.29411	....	8.85964	0.35740	2.17857	0.15894	....	3.33333	3.76744	....	1.97312	0.00328	0.00545
Taxes on warehouse	0.79814	....	0.82352	0.83963	....	0.47666	0.72571	0.78947	2.30791	1.40277	....	....	0.59647	0.00099	0.00164
Insurance:															
Stock	....	....	....	0.38224	0.27894	0.37981	1.02500	....	....	1.28888	0.32558	....	0.27176	0.00045	0.00075
Warehouse	0.74111	....	0.89388	....	....	0.66067	....	2.36842	5.29833	....	....	....	0.55796	0.00092	0.00154
Employer's liability	0.20472	....	0.26341	....	....	0.49382	....	0.65105	....	....	0.37674	....	0.19621	0.00032	0.00054
Fuel	0.83333	1.83870	1.18223	0.31159	1.29973	0.95679	1.07142	0.63578	1.07333	0.66666	1.16279	1.76700	0.95021	0.00158	0.00262
Light and power	0.34351	0.21387	0.24329	0.31166	0.50824	1.13345	0.14642	0.32000	0.58208	....	0.81395	....	0.52324	0.00087	0.00144
Linings	2.41055	1.06548	1.52576	0.60978	3.84035	1.94487	1.25714	3.82368	1.33333	4.51388	0.46511	1.20000	1.93997	0.00322	0.00536
Repairs	0.12805	....	....	0.16369	....	0.77160	....	6.98263	3.09208	....	0.04651	....	0.47474	0.00078	0.00131
Supplies	....	....	....	....	0.48666	....	....	....	....	0.39166	....	....	0.08016	0.00013	0.00022
Miscellaneous operating expenses	2.41879	2.41935	0.37717	0.10144	....	0.12623	....	0.70684	....	....	3.47790	....	0.72528	0.00120	0.00200
Depreciation:															
Warehouse	2.08333	....	3.10423	0.84057	....	2.71604	0.89285	....	4,45833	4.44444	....	....	1,61135	0.00268	0.00445
Equipment	0.92592	0.32258	0.99117	1.57971	....	1.81716	1.14285	2.36842	1.73750	1.19444	1.33720	1.50000	1.17862	0.00196	0.00325
Officers' salaries	....	....	....	....	....	....	....	....	....	....	....	....	....		
Manager's salary	13.12287	16.69193	15.88235	17.92282	26.31579	6.17284	1.66678	26.31578	21.84166	12.85833	7.69813	16.24500	14.81263	0.02464	0.04093
Office salaries	3.22222	....	....	0.32210	....	4.24907	1.27142	....	....	....	4.20000	....	1.66282	0.00276	0.00459
Travel	....	....	....	0.60717	2.80701	....	....	....	0.37500	....	2.93023	....	0.69075	0.00114	0.00190
Office supplies	0.37296	0.22451	0.64470	0.29434	0.41710	0.18296	0.42107	0.42421	0.27500	4.24111	0.34883	0.50000	0.43928	0.00073	0.00121
Telephone and telegraph	1.67999	2.21612	1.09552	1.80268	....	0.92722	0.37428	2.71842	1.67750	2.06000	1.62790	0.90000	1.26757	0.00210	0.00350
Inspection	2.48148	2.32258	....	0.52173	1.05263	2.41975	....	0.21052	1.33333	....	1.95348	2.80000	1.37435	0.00228	0.00379
Office rent	....	0.64516	....	....	.87719	....	....	....	....	....	0.41860	....	0.17692	0.00029	0.00048
Brokerage and commissions	9.01620	3.87096	12.35082	5.16101	30.56105	12.15407	27.20107	30.80684	28.84583	25.04055	28.91627	38.98800	15.93843	0.02651	0.04404
Advertising and publicity	1.09861	....	0.65200	....	....	....	1.83928	0.22368	2.08333	....	....	....	0.35874	0.00059	0.00099
Market service	....	....	1.02352	....	....	....	....	....	....	....	....	....	0.11153	0.00018	0.00300
Interest on borrowed money	0.55555	1.30645	2.13047	2.28065	1.32535	....	....	....	....	....	1.25581	1.60000	1.04796	0.00174	0.00289
Interest on investment	3.79120	0.68838	6.99952	....	....	4.61864	2.95428	7.15105	13.23541	7.64833	0.57279	0.64500	3.17815	0.00528	0.00878
Miscellaneous office expenses	....	....	0.08235	....	....	....	....	....	....	....	....	....	0.00897	0.00001	0.00002
Depreciation on furniture and fixtures	0.21490	....	....	0.05072	....	0.06172	....	0.06578	0.02083	....	0.31935	....	0.07110	0.00011	0.00019

Bad debts	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Demurrage	0.38888	.....	0 40000	0 13043	5 30526	0 24691	.....	2 21052	.....	.....	.....	2 32300	1 03080	0 00171	0 00284
Bank exchange	0.84833	0 70161	0 20529	1 01326	1 21763	0 89172	.....	.....	.....	.....	.....		0 71015	0 00118	0 00196
Storage	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Freight, express, and drayage*	0 97064	10 19290	1 35458	.	7 62000	0 35932	0 87071	4 49052	..	0 35222	5 61116		2 33353	0 00388	0 00644
Total operating cost	$91 55766	$92 71573	$91 44671	$78 63127†	$128 89309	$98 35409	$96 27349	$148 43570	$125 87036‡	$107 62104	$108 65850	$125 25200	$100.52878	$0 16722	$0 27782

* See first footnote to table 22, page 56.
† Cooperative no. 104 let part of a warehouse for $331. This amount is deducted from the total cost ($81.02982 - $2.39855 = $78.63127).
‡ Cooperative no. 109 let part of a warehouse for $30. This amount is deducted from the total cost ($127.12036 - $1.25 = $125 87036).
§ Weighted averages per car, per bushel, and per hundredweight are adjusted according to those made for cooperatives nos 104 and 109.

TABLE 33. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

	Western New York										Average for western New York coopera-tives	Northern New York		Average for western and northern New York coopera-tives
Cooperative no.	101	102	103	104	106	107	109	110	111	112		105	108	
Number of carloads	108	31	85	138	162	28	24	18	43	10		114	19	
Labor and management	$23.55	$34.35	$20.16	$21.06	$28.31	$22.26	$20.95	$19.29	$16.43	$24.36	$23.55	$41.68	$48.06	$26.79
Warehouse costs	7.13	2.58	10.03	3.41	8.45	6.25	23.66	17.00	3.77		7.35	7.80	14.09	7.59
Equipment costs	1.29	0.45	1.37	1.83	2.88	2.25	2.61	1.88	1.71	1.50	1.91	0.97	3.72	1.82
General office costs	12.91	8.73	14.29	10.58	6.42	4.85	16.49	11.22	11.21	10.87	10.36	12.51	16.52	10.83
Telephone and telegraph	1.68	2.22	1.10	1.80	0.93	1.37	1.68	2.06	1.63	0.90	1.4[illegible]		2.72	1.27
Bank exchange	0.85	0.70	0.21	1.01	0.89						0.61	1.2[illegible]		0.71
Brokerage and commissions	9.02	3.87	12.35	5.16	12.15	27.20	28.85	25.04	28.92	38.90	12.92	30.56	30.81	15.94
Linings	2.41	1.07	1.53	0.61	1.94	1.26	1.33	4.51	0.47	1.20	1.55	3.81	3.82	1.94
Sacks, tags, and twine	25.38	22.19	26.97	31.29	31.05	28.81	27.52	25.32	28.83	40.51	28.81	11.68	20.76	26.15
Miscellaneous	7.34	16.56	3.44	1.88	5.33	2.02	2.78	1.30	15.69	6.89	5.58	18.21	7.94	7.49
Total operating costs	$91.56	$92.72	$91.45	$78.63	$98.35	$96.27	$125.87	$107.62	$108.66	$125.25	$94.1[illegible]	$128.80	$148.44	$100.53
Amount paid to growers	287.08	331.25	289.18	309.16	296.70	275.86	234.90	332.70	280.61	401.35	296.78	417.73	401.78	317.01
Total cost of potatoes to shipper	$378.64	$423.97	$380.63	$387.79	$395.06	$372.13	$360.77	$440.32	$389.27	$526.60	$390.90	$546.6[illegible]	$550.22	$417.54
Gross sales	$474.87	$521.02	$481.84	$507.89	$493.13	$483.30	$470.66	$519.69	$481.18	$668.16	$494.[illegible]	$703.30	$562.85	$526.66
Claims and allowances	$8.43	$7.87	$0.29	$21.11	$16.79	$5.48	$5.95	$1.10	$1.60	$1.90	$11.15	$2.35		$9.59
Freight	97.70	102.98	100.24	104.43	98.16	105.01	114.63	87.07	93.81	137.01	100.81	101.12	$127.00	101.52
Net sales	$368.74	$410.17	$381.30	$382.35	$378.18	$372.81	$350.08	$431.52	$385.77	$529.25	$382.40	599.84	$435.85	$415.55
Net profit			$0.67			$0.68				$2.65		$53.2[illegible]		
Net loss	$9.90	$13.80		$5.44	$16.88		$10.69	$8.80	$3.50		$8.41		$114.37	$1.99

104 received $331 rental for the use of part of its warehouse during this season. Cooperative no. 109 received $30 rental on a similar basis. These credits have been deducted from the total primary costs listed in table 32 but not from the individual warehouse costs. In all subsequent tables they have been deducted from group warehouse costs.

The variation in group operating costs and returns per 600-bushel carload for the twelve cooperatives studied during the 1922–23 season are shown in table 33.

Labor and management.— As in the previous season, there was a wide variation in the cost for labor and management, this ranging from $16.43 to $48.06 per carload, with an average of $26.79. This compares closely with the results for the 1921–22 season, the average of which was $27.92 per carload. Three of the cooperatives paid their managers on a salary basis, and nine paid on the basis of the volume handled (table 34).

TABLE 34. BASIS OF PAYMENT FOR LABOR AND MANAGEMENT, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

Cooperative no.	Basis of payment of manager	Source of payment for extra hired labor
101	5 cents per bushel, or 9 cents per hundredweight	Manager
102	7 cents per bushel, or 11.6 cents per hundredweight.	Manager
103	Salary $1300 per annum	Cooperative
104	5 cents per bushel, or 9 cents per hundredweight.	Manager
105	Salary $3000 per annum	Cooperative
106	5 cents per bushel, or 9 cents per hundredweight	Manager
107	4.8 cents per bushel, or 8 cents per hundredweight	Manager
108	Salary $1000 per annum	Cooperative
109	6 cents per bushel, or 10 cents per hundredweight	Manager
110	4 cents per bushel, or 6.6 cents per hundredweight	Manager
111	4 cents per bushel, or 6.6 cents per hundredweight	Manager
112	4 cents per bushel, or 6.6 cents per hundredweight	Manager

Where straight salaries were paid to the managers, these ranged from $1000 to $3000 per annum regardless of the volume handled. The average salary paid was $1766 per annum. The cooperatives hiring managers on this basis paid also for the additional labor required for handling the potatoes. The rates paid to managers for handling potatoes on the unit basis ranged from 4 cents a bushel (equivalent to 6.6 cents a hundredweight) to 7 cents a bushel (equivalent to 11.6 cents a hundredweight); the average rate paid to managers on the unit basis was 8.5 cents a hundredweight. As in the 1921–22 season, cooperatives evidently preferred to hire managers on the unit-handled basis rather than on the salary basis, since 75 per cent of the managers were so hired.

Warehouse costs.— Eleven of the twelve cooperatives had at least one warehouse. One of them had three and one had two warehouses. One did not use a warehouse, but did entirely a car-door business. The remaining nine cooperatives used one warehouse each. Three of the fourteen warehouses were rented by the cooperatives; the remainder were owned. The average value was $3091.98 per warehouse, or $56.22 per carload

handled. This compares with an average value of warehouses used by single-station dealers of $1916.60 per warehouse, or $32.27 per carload handled, and with an average value for warehouses used by many-station dealers of $1446.62 per warehouse, or $47.62 per carload handled (table 15).

The warehouse cost for these cooperatives averaged $7.59 per 600-bushel carload, or about 1.25 cents per bushel handled; the range was from $2.58 to $17 per carload.

Equipment costs.— The average cost for use of equipment in handling potatoes was $1.82, ranging from 45 cents to $3.72 a carload. Two of the cooperatives installed dumping and grading equipment at the beginning of the 1922–23 season. The remainder used hand-driven or electrically driven graders without dumping attachments.

Brokerage and commissions.— There was a wide range in the amount of brokerage and commissions paid for selling these potatoes. The average selling cost per carload was $15.94, ranging from $3.87 to $38.99. It should be borne in mind, however, that the brokerage and commission charges paid by cooperatives nos. 107 to 112, inclusive, included brokerage and commissions, bank exchange, certain claims and allowances, and sundry services. Cooperative no. 105 sold a large proportion of its potatoes on the joint-account basis, and the charge of $30.56 per carload represents the pay of the joint-account sales agent in the terminal market. For some reason not known to the writer, the brokerage and commission charges per carload paid by cooperatives nos. 101 to 106, inclusive, were higher than during the 1921–22 season.

Sacks, tags, and twine.— The cost of sacks, tags, and twine ranged from $11.98 to $40.54 per carload, with an average of $26.15 per carload. The proportion of potatoes shipped in bulk influenced this cost to some extent. Cooperative no. 105 shipped 52.5 per cent of all its potatoes in bulk; cooperative no. 108, 16.4 per cent; cooperative no. 110, 14.8 per cent; and cooperative no. 101, 14 per cent. Each of the remaining cooperatives shipped less than 8 per cent in bulk. Two shipped all of their potatoes in sacks. Variations in quality and the branding of sacks probably account for some of the range in cost.

Total operating costs.—The total cost of handling a 600-bushel carload of potatoes, for these associations, was $100.53. The highest cost was $148.44 and the lowest was $78.63. The difference between the highest and the lowest cost was equal to 11.6 cents a bushel. Cooperative no. 104, which had the lowest cost during this season, had the second lowest cost in 1921–22.

The total operating costs of the cooperatives that were affiliated with the Empire State Potato Growers' Cooperative Association, Inc., averaged $115.48 per carload; the independent cooperatives averaged $97.20. On the other hand, the bank exchange and the claims and allowances averaged $11.97 a carload for the independent cooperatives, as compared with $2.84 for those affiliated with the central selling association.

Amount paid to growers.—An analysis of the 1922–23 data shows again that a low handling cost does not necessarily mean high returns to the grower. Cooperative no. 105, which had the second highest operating cost, paid the highest amount per carload to the grower. This may have been due to the joint-account method of selling, to the better quality of

the potatoes, or to both causes. The cooperative with the lowest handling cost ranked sixth in returns to the grower. The explanation of some of these facts may be found in the amounts paid for linings or in the amount of claims and allowances per carload.

Comparisons of group operating costs and returns on different bases

Bushel and hundredweight bases.— The group costs and returns are shown on the bushel and hundredweight bases, in tables 35 and 36.

As percentages of total operating costs.— Labor and management constituted, on the average, about 27 per cent of the total operating costs for these twelve cooperatives, the range being from 15 to 37 per cent; sacks, tags, and twine averaged about 26 per cent of the total cost; brokerage and commissions, about 16 per cent; and general office costs, about 11 per cent. The four items mentioned made up approximately 79 per cent of the total operating costs. Variations in these percentages are given in table 37.

As percentages of net sales.— For each $100 of net sales, these cooperatives expended an average of $24.19 for operating expenses, and permitted deductions of $2.31 for claims and allowances (table 38). Labor and management alone took $6.45 of every $100; sacks, tags, and twine, $6.29; and brokerage and commissions, $3.83.

Score cards showing relative standing in efficiency.—An attempt is made in tables 39 and 40 to furnish an easy basis of comparison of the average costs and returns for these cooperatives with those for the thirty-four marketing agencies studied during the 1922–23 season. The average costs and returns for the entire thirty-four agencies were considered as 100 per cent, and each group cost for each cooperative is expressed as percentage of the average.

From the point of view of costs, cooperative no. 103 was probably the most efficient in 1922–23, but it had relatively high warehouse and general office costs. From the point of view of returns, however, this cooperative ranked seventh (table 40). Cooperative no. 102 had the second lowest cost and the fifth highest returns; the labor and management and the miscellaneous costs were relatively high in this case, and claims and allowances were also above average. Cooperative no. 105, which ranked fourth highest in costs and allowances, was highest in returns to the grower. This may have been due either to the joint-account method of selling, to the better quality of the potatoes, or to both causes.

TABLE 35. GROUP OPERATING COSTS AND RETURNS PER BUSHEL, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

	Western New York										Weighted average for western New York coopera-tives	Northern New York		Weighted average for western and northern New York coopera-tives
Cooperative no.	101	102	103	104	106	107	109	110	111	112		105	108	
Number of bushels	64,607	18,734 5	51,077 5	83,034	97,100	16,920	14,325	10,710	25,918	6,123		68,213	12,144	
Labor and management	$0.03936	$0 05684	$0 03355	$0 03499	$0 04722	$0 03683	$0 03510	$0 03241	$0 02725	$0 03979	$0 03921	$0 06965	$0 07519	$0 04457
Warehouse costs	0 01191	0 00427	0 01669	0 00566	0 01410	0 01035	0 03964	0 02857	0 00625		0 01223	0 01319	0 02204	0 01262
Equipment costs	0 00216	0 00075	0 00228	0 00304	0 00479	0 00371	0 00437	0 00315	0 00284	0 00244	0 00318	0 00161	0 00631	0 00302
General office costs	0 02157	0 01444	0 02378	0 01758	0 01071	0 00802	0 02762	0 01885	0 01859	0 01774	0 01725	0 02091	0 02584	0 01800
Telephone and telegraph	0 00280	0 00366	0 00182	0 00299	0 00154	0 00227	0 00281	0 00346	0 00270	0 00146	0 00241		0 00425	0 00210
Bank exchange	0 00141	0 00116	0 00034	0 00168	0 00148	..		. . .		.	0 00106	0 00203		0 00118
Brokerage and commissions	0 01507	0.09640	0 02055	0 00857	0 02027	0 04501	0 04832	0 04208	0 04797	0 06367	0 02152	0 05107	0 04819	0 02651
Linings	0 00402	0 00176	0 00253	0 00101	0 00324	0 00208	0 00223	0 00758	0 00077	0 00195	0 00258	0 00641	0 00598	0 00322
Sacks, tags, and twine	0 04242	0 03671	0 04488	0 05200	0 05180	0 04766	0 04610	0 04256	0 04784	0 06629	0 04796	0 02001	0 03248	0 04350
Miscellaneous	0 01233	0 02742	0 00575	0 00316	0 00894	0 00338	0 00469	0 00221	0 02606	0 01130	0 00933	0 03052	0 01195	0 01250
Total operating costs	$0 15305	$0 15341	$0 15217	$0 13068	$0 16409	$0 15931	$0 21088	$0 18087	$0 18027	$0 20455	$0 15673	$0 21540	$0 23223	$0 16722
Amount paid to growers	0 47989	0 54812	0 48123	0 51380	0 49501	0 45650	0 39355	0 55915	0 46555	0 65547	0 49418	0 69811	0 62862	0 52733
Total cost of potatoes to shipper	$0 63294	$0 70153	$0 63340	$0 64448	$0 65910	$0 61581	$0 69443	$0 74002	$0 64582	$0 86002	$0 65091	$0 91351	$0 86085	$0 69455
Gross sales	$0 79381	$0 86212	$0 80184	$0.84409	$0 82272	$0 79977	$0 78854	$0 87342	$0 79831	$1 09122	$0 82338	$1 17536	$0 88961	$0 87607
Claims and allowances	$0 01498	$0 01302	$0 00048	$0 03509	$0 02831	$0 00936	$0 00996	$0 00185	$0 00265	$0 00319	$0 01857	$0 00390		$0 01595
Freight	0 16331	0 17039	0.16681	0 17355	0.16377	0 17376	0 19205	0 14634	0 15564	0 22375	0 16790	0 15599	$0 19570	0 16886
Net sales	$0 61642	$0 67871	$0 63455	$0 63545	$0 63394	$0 61695	$0 67653	$0 72523	$0 64002	$0 86437	$0 63691	$1 00247	$0 68141	$0 69126
Net profit	. . .	. . .	$0 00115	. .		$0 00114	.			$0 00435		$0 08896	.	
Net loss	$0 01652	$0 02282	. .	$0 00903	$0 02516	.	$0 01790	$0 01479	$0 00580		$0 01400	..	$0 17914	$0 00329

TABLE 36. GROUP OPERATING COSTS AND RETURNS PER HUNDREDWEIGHT 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

	Western New York										Weighted average for western New York coopera-tives	Northern New York		Weighted average for western and northern New York coopera-tives
Cooperative no.	101	102	103	104	106	107	109	110	111	112		105	108	
Number of hundredweights	38,764 4	11,240 7	30,646 5	49,820 3	58,259 9	10,152 28	8,594 8	6,426 1	15,550 58	4,873 5		4,0917 7	6,992 68	
Labor and management	$0 06560	$0 09474	$0 05591	$0 05832	$0 07871	$0.06139	$0.05850	$0.05402	$0 04542	$0.04999	$0 06496	$0 11613	$0 13058	$0 07405
Warehouse costs	0 01985	0 00711	0.02782	0 00944	0.02350	0.01726	0.06607	0 04762	0.01041	......	0 02028	0 02199	0 03828	0 02098
Equipment costs	0 00360	0 00125	0 00381	0 00507	0.00799	0 00619	0 00728	0.00525	0 00473	0 00307	0 00528	0 00268	0 01010	0.00502
General office costs	0 03596	0 02406	0 03963	0 02930	0 01785	0.01338	0 04603	0.03141	0 03100	0 02230	0 02860	0 03486	0 04488	0 02991
Telephone and telegraph	0 00468	0 00611	0 00303	0 00499	0.00257	0 00379	0 00468	0 00577	0 00450	0 00184	0 00399		0 00738	0 00350
Bank exchange	0 00236	0 00193	0 00056	0 00280	0 00247				....		0 00177	0 00339		0 00196
Brokerage and commissions	0 02511	0 01067	0 03425	0 01429	0 03379	0 07502	0 08054	0 07014	0 07995	0 07999	0 03568	0 08514	0 08370	0 04404
Linings	0 00671	0 00293	0 00423	0 00168	0 00510	0 00346	0 00372	0 01264	0 00128	0 00246	0 00427	0 01069	0 01038	0 00536
Sacks, tags, and twine	0 07071	0 06119	0 07480	0 08667	0 08633	0 07944	0 07684	0 07094	0 07973	0 08318	0 07953	0 03337	0 05641	0 07227
Miscellaneous	0 02050	0 04570	0 00959	0 00524	0 01187	0 00559	0.00781	0 00366	0 04343	0 01417	0 01552	0 05085	0 02160	0 02073
Total operating costs	$0 25508	$0 25569	$0 25363	$0 21780	$0 27348	$0.26552	$0 35147	$0 30145	$0 30045	$0 25700	$0 25988	$0 35910	$0 40331	$0 27782
Amount paid to growers	0 79982	0 91354	0 80206	0 85634	0 82502	0 76082	0.65593	0 93191	0 77594	0 82352	0 81942	1 16382	1 09170	0 87609
Total cost of potatoes to shipper	$1 05490	$1 16923	$1 05569	$1 07414	$1 09850	$1 02634	$1 00740	$1 23336	$1 07639	$1 08052	$1 07930	$1 52292	$1 49501	$1 15391
Gross sales	$1 32301	$1 43688	$1 33641	$1 40683	$1 37121	$1 33292	$1 31426	$1 45568	$1 33054	$1 37100	$1 36528	$1 95943	$1 52934	$1 45548
Claims and allowances	$0 02348	$0 02170	$0 00081	$0 05849	$0 04668	$0.01510	$0 01661	$0 00308	$0 00441	$0 00389	$0 03079	$0 00650		$0 02651
Freight	0 27219	0 28399	0 27802	0 28926	0 27295	0 28960	0 32009	0 24389	0.25940	0 28112	0 27841	0 28173	$0 34509	0 28054
Net sales	$1 02734	$1 13119	$1 05758	$1 05908	$1 05158	$1 02822	$0 97756	$1 20871	$1 06673	$1 08599	$1 05608	$1 67120	$ 1 18425	$1 14843
Net profit			$0 00189			$0 00188				$0 00547		$0 14828		
Net loss	$0.02756	$0.03804	.	$0 01506	$0 04692		$0.02984	$0 02465	$0 00966		$0 02322		$0 31076	$0 00548

TABLE 37. GROUP OPERATING COSTS AS PERCENTAGES OF TOTAL OPERATING COSTS, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

	Western New York										Average for western New York coopera-tives (per cent)	Northern New York		Average for western and northern New York coopera-tives (per cent)
Cooperative no.	101	102	103	104	106	107	109	110	111	112		105	108	
Groups	Per cent											Per cent		
Labor and management	25.72	37.05	22.05	26.78	28.78	23.12	16.65	17.92	15.12	19.45	25.02	32.34	32.38	26.65
Warehouse costs	7.78	2.78	10.97	4.34	8.60	6.50	18.80	15.80	3.47	.	7.81	6.13	9.49	7.55
Equipment costs	1.41	0.49	1.50	2.33	2.92	2.34	2.07	1.74	1.58	1.20	2.03	0.75	2.50	1.81
General office costs	14.10	9.41	15.63	13.45	6.52	5.04	13.10	10.42	10.32	8.68	11.01	9.71	11.13	10.77
Telephone and telegraph	1.84	2.30	1.20	2.29	0.94	1.43	1.33	1.92	1.50	0.72	1.54		1.83	1.26
Bank exchange	0.93	0.76	0.22	1.29	0.91	.....	....	.....	...	...	0.68	0.94		0.71
Brokerage and commissions	9.85	4.18	13.51	6.56	12.36	28.25	22.92	23.27	26.61	31.13	13.73	23.71	20.75	15.86
Linings	2.63	1.15	1.67	0.78	1.98	1.31	1.06	4.19	0.43	0.96	1.65	2.98	2.58	1.93
Sacks, tags, and twine	27.72	23.93	29.49	39.79	31.57	29.92	21.86	23.53	26.53	32.36	30.60	9.29	13.99	26.01
Miscellaneous	8.02	17.86	3.76	2.39	5.42	2.09	2.21	1.21	14.44	5.50	5.93	14.15	5.35	7.45

TABLE 38. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23

	Western New York										Average for western New York coopera-tives (per cent)	Northern New York		Average for western and northern New York coopera-tives (per cent)
Cooperative no.	101	102	103	104	106	107	109	110	111	112		105	108	
Groups	Per cent											Per cent		
Labor and management	6.39	8.37	5.29	5.51	7.48	5.97	5.98	4.47	4.26	4.61	6.15	6.95	11.03	6.45
Warehouse costs	1.93	0.63	2.63	0.89	2.24	1.68	6.76	3.94	0.98	.....	1.92	1.32	3.23	1.83
Equipment costs	0.35	0.11	0.36	0.48	0.76	0.60	0.75	0.43	0.44	0.28	0.50	0.16	0.85	0.44
General office costs	3.50	2.13	3.75	2.77	1.70	1.30	4.71	2.60	2.91	2.05	2.71	2.09	3.79	2.60
Telephone and telegraph	0.46	0.54	0.29	0.47	0.25	0.37	0.48	0.48	0.42	0.17	0.38	....	0.62	0.31
Bank exchange	0.23	0.17	0.05	0.27	0.24	.....	.....	.....	.....	....	0.17	0.20	....	0.17
Brokerage and commissions	2.45	0.94	3.24	1.35	3.21	7.30	8.24	5.80	7.50	7.37	3.38	5.09	7.07	3.83
Linings	0.65	0.26	0.40	0.16	0.51	0.33	0.38	1.05	0.12	0.23	0.41	0.64	0.88	0.47
Sacks, tags, and twine	6.88	5.41	7.07	8.18	8.21	7.73	7.86	5.87	7.47	7.66	7.53	2.00	4.77	6.29
Miscellaneous	1.99	4.04	0.90	0.49	1.41	0.54	0.79	0.30	4.07	1.30	1.46	3.04	1.82	1.80
Total operating costs	24.83	22.60	23.98	20.57	26.01	25.82	35.95	24.94	28.17	23.67	24.61	21.49	34.06	24.19
Claims and allowances	2.29	1.92	0.08	5.52	4.44	1.47	1.70	2.55	0.41	0.30	2.92	0.39	. .	2.31

TABLE 39. SCORE CARD OF OPERATING COSTS, AND CLAIMS AND ALLOWANCES, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23*

Cooperative no.	101	102	103	104	105	106	107	108	109	110	111	112
Groups	Per cent of average											
Labor and management	84	123	72	75	149	101	79	172	75	69	59	87
Warehouse costs	111	40	156	53	122	132	97	219	369	265	59	0
Equipment costs	102	35	108	144	76	227	177	293	206	148	135	118
General office costs	126	85	139	103	123	63	47	161	161	109	109	106
Telephone and telegraph	62	82	40	66	0	34	50	100	62	76	60	33
Brokerage and commissions	79	34	108	45	268	107	239	270	253	220	254	342
Linings	117	52	74	30	186	94	61	185	65	219	23	58
Sacks, tags, and twine	111	97	118	137	52	136	126	91	120	111	126	177
Miscellaneous	94	211	44	24	232	68	26	101	35	17	200	88
Claims and allowances	116	108	4	290	32	230	75	0	82	15	22	26
Total score	1,002	867	863	967	1,240	1,192	977	1,592	1,428	1,249	1,047	1,035

* The lowest score is the most efficient. Average = 1000.

TABLE 40. SCORE CARD OF RETURNS, 12 COOPERATIVE ASSOCIATIONS, SEASON 1922–23*

Cooperative no.	101	102	103	104	105	106	107	108	109	110	111	112
Items	Per cent of average											
Amount paid to growers, plus net profits or minus net losses	86	98	90	94	146	87	86	89	69	100	86	125
Net sales	89	99	92	92	144	91	90	105	84	104	93	127
Total score	175	197	182	186	290	178	176	194	153	204	179	252

* The highest score is the most efficient. Average = 200

SINGLE-STATION DEALERS

Season 1921–22

The records of eight single-station dealers were studied for the 1921–22 season. The single-station dealer bought the potatoes for cash from the grower, and assumed all risks of loss involved in the further merchandising to the city wholesalers or receivers. This method of sale differed from that of the cooperatives in that each member of the cooperative automatically carried the risk on his proportional share of the potatoes handled by his association. If any profit were made from the potato-dealing activities of the single-station dealer, the dealer got it. He likewise stood any loss. A cooperative was not supposed to make a profit, but any surplus could be used for the reduction of indebtedness, or could be distributed, on the basis of patronage, as dividends in some form to the members of the cooperative. Losses might likewise be distributed among members by assessment.

Five of the eight single-station dealers were located in Franklin County, two in Clinton County, and one in Steuben County. It was difficult to find single-station dealers in western New York. Most of those who would otherwise have been single-station dealers were employed by a many-station dealer. All but one of the single-station dealers were engaged in other lines of work as well as dealing in potatoes. Four of them dealt in hay, feed, fertilizer, and seeds; one of these four did a large business in farm machinery also, while another gave considerable time to a banking business. One dealer was engaged in a farm-real-estate business, and traded in livestock, Christmas trees, and hay. Two dealers conducted general country stores and shipped a variety of agricultural products, such as calves, eggs, live poultry, and butter, as well as potatoes. The single-station dealer in Steuben County did not engage in any other line of business. All of the dealers had been engaged in the handling of potatoes for a number of years, varying from five to thirty. They probably should be classified as experienced dealers.

Volume of potatoes shipped

During the 1921–22 season, these eight single-station dealers received and shipped 25,248,783 pounds of potatoes, or 420,813 bushels, equivalent to 702 carloads of 600 bushels each. These potatoes actually moved to market in 640 shipments. Of the total volume, 21,314,703 pounds, or 84.4 per cent, were shipped in bulk, and 3,934,080 pounds, or 15.6 per cent, were shipped in sacks. None of the potatoes sold by these single-station shippers were shipped by truck.

Several of the dealers in Franklin County were disturbed by competition on the part of truck operators from cities in St. Lawrence and Jefferson Counties. They stated that these truck operators, who bought only intermittently, went directly to the farms and bought potatoes field-run. This made grading at the shipping point unpopular.

All of the potatoes shipped by these eight dealers during the 1921–22 season were sold as United States no. 1 grade. The dealers bought none of the United States no. 2 grade potatoes, but returned them to the grower together with the culls.

The average number of destinations to which these dealers shipped their potatoes was 11, and the number of carloads shipped per destination was slightly in excess of 8. The destinations, on the average, were scattered over 3 States, and the average number of carloads per State was 34. Seven of the dealers were located in Franklin and Clinton Counties along the Rutland Railroad, which runs through western Vermont and connects at Troy, New York, with the New York Central Railroad. This permitted ready access to the only railroad yards on Manhattan Island, but the long haul to such cities as Philadelphia, Pittsburgh, and Baltimore was a disadvantage. A large proportion of the potatoes shipped by these dealers went to New York City or to points between New York and the shipping stations.

These eight single-station dealers handled 11.9 per cent of the volume of potatoes shipped by all the agencies studied, and approximately 4.9 per cent of all up-state potatoes shipped in carloads during the 1921–22 season.

Primary and group operating costs

The items of expense incurred in the handling and shipping of potatoes by these dealers during the 1921–22 season are shown in table 41.

Labor and management.— The cost of labor and management, as used here, represents all cost of hired labor and compensation for the dealer. An estimate was made by each dealer of the amount that he could earn in similar work. This estimated amount was allocated between labor and management, and general office costs.

The cost of labor and management per carload varied within wide limits (table 42). The lowest cost was $11.84 and the highest was $42.41, the average being $26.75 for the group. The lowest cost was obtained by the dealer who handled the largest volume and had the most diversified business. Judged by the average for all agencies studied in 1921–22, labor and management costs for five of these dealers were relatively high. While diversity in business offers a possibility of making better use of labor, diversity alone does not insure low costs. It seems that several of the dealers were obliged to retain help which was idle for a good share of the time, because they dealt in products that were bought or sold throughout the year. It is necessary to have sufficient volume as well as diversity if low costs are to be obtained.

Warehouse costs.— On the whole, the warehouses used in the northern New York area were rather more substantially built than those in western New York (figures 32 to 35.) This was probably because of the lower winter temperatures in northern New York. One of these dealers did only a car-door business; six had one warehouse each; and one rented a cellar under a store. The warehouse costs averaged $4.28 per carload, and ranged from 70 cents to $9.68. The average investment was $1994.29 per warehouse, or $20.41 per carload handled. A low warehouse cost is not necessarily economical. The dealer whose warehouse cost was only 70 cents per carload rented a cellar which was very inconvenient. There was probably a definite relation between the inconvenience of handling potatoes in that cellar, and the relatively high labor and management cost of this dealer.

TABLE 41. PRIMARY OPERATING COSTS PER 600-BUSHEL CARLOAD, 8 SINGLE-STATION DEALERS, SEASON 1921–22

Dealer no.	26	27	28	29	30	31	32	33	Weighted averages		
Number of 600-bushel cars	81	43	151	103	221	45	40	18	Per car	Per bushel	Per hundred-weight
Labor	$17.45506	$29.65116	$17.84092	$21.10194	$ 9.16289	$ 8.24711	$28.96725	$15.55555	$16 22670	$0 02706	$0 04511
Sacks, tags, and twine	0.41358	0.22465	0.95298	0.47087	7 30995	1.79244	15 72725		3.64787	0 00608	0 01014
Rent for warehouse		0.69767	0.45251	0.43689	0.35294	0 22222			0.32952	0 00054	0.00091
Taxes on warehouse	0.44444		0.99337	0.24271	0 27149	0 24577	1 12500		0 46589	0 00077	0 00129
Insurance:											
Stock	1.04938			0.71844			1.50000		0 31196	0.00052	0.00086
Warehouse	0.35580		0.44874	0.13592	0.10859	0 43422	1 00000		0 27652	0 00046	0.00076
Employer's liability	0.25925	1.74418			0 27149				0 22222	0.00037	0 00061
Fuel	7.40740	0 48837	1.92258	1.94174	1.35746	0.56844	10 62500	1 11111	2.68075	0.00447	0.00745
Light and power			0.18079	0.14563	0 21719		0 34500		0.14829	0.00024	0.00041
Linings	1.85185	1.62790	1.19847	4.89320	1.35746	0 78577	2.50000	7 50000	2 10160	0 00350	0.00584
Repairs	1.11111		1.43258	1.94174	0.67873		1.55000		1.02324	0 00170	0.00284
Supplies	0.86419		0.65827	1.14563			0.50000		0 43789	0.00073	0.00121
Miscellaneous operating expenses		0.46511	0.38933		1.13122	0.26888		0.69444	0.50340	0 00083	0.00139
Depreciation:											
Warehouse	1 85185		1.42384	1.45631	0.45248	1.66666	3.12500		1.17521	0.00196	0.00326
Equipment	0.12345	0.27906	0.39735	0.16504	0.33936	0.27777	1.81250	0.55555	0 38319	0 00063	0.00106
Officers' salaries					4.82352				1.51851	0.00253	0.00422
Manager's salary	24.69135	8.37209	22.25165	9.32038		27.99999	22.50000	16.66666	13.01993	0.02171	0.03619
Office salaries	1.97530			3.59223	1.95475				1.35612	0.00226	0.00377
Travel			1.37701		1.13122		2.50000	5.55555	0.93722	0 00156	0.00260
Office supplies	0.61728	0.23255	0.24238	0.09708	0.06787	0.13599	0.12500	0.27777	0.19618	0 00032	0 00054
Telephone and telegraph	0.86410	3.23441	3.40642	0.97087	1.04072	1.26777	4 50000	1.94444	1 88817	0.00314	0.00524
Inspection				0.09708					0.01424	0 00002	0.00003
Office rent	1.11111	2.09302		0 77669		1.05244	2.40000		0 57458	0.00095	0.00159
Brokerage and commissions	45.62382		0.26490	6.69902	22.76040	42 00266	2.50000		16.30441	0.02719	0.04533
Advertising and publicity			0.02039		0.18099				0.06136	0.00010	0 00017
Market service		0.13953	0.00741		0.04524		2.22500	0.27777	0.15829	0 00026	0.00044
Interest on borrowed money	2.22222	6.97674		2.91262	1.35746		1 50000	0.69444	1 64173	0.00273	0 00456
Interest on investment	1.73802	0.07534	1.77629	0.85485	1.12104	5.10777	4.14575	0.36666	1.63863	0.00273	0.00455
Miscellaneous office expenses											
Depreciation on furniture and fixtures	0.12185		0.05192		0.01809				0.03092	0.00005	0.00008
Bad debts					2.26244				0.71225	0.00118	0.00198
Demurrage	0.24601	4.41860	0.59337	0.80601	0.45248	1.81466	0.62500	0 55555	0 85367	0.00142	0.00237
Bank exchange	0.55629		1.43509	0.28242	0.90497		1.52000		0 78582	0 00131	0.00218
Storage						0.26888			0.01723	0 00002	0.00004
Freight, express, and drayage *	0 20148		0.22582			0.88177			0 12834	0 00021	0 00035
Legal expenses				5.82524					0 85470	0.00142	0 00237
Total operating costs	$113.15718	$60.72038	$59.94438	$67.03055	$61.13244	$95.04121	$113.31775	$51 75549	$72 62655	$0.12097	$0.20174

* See first footnote to table 22, page 56.

TABLE 42. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 8 SINGLE-STATION DEALERS, SEASON 1921-22

	Northern New York							Average for northern New York dealers	Western New York	Average for northern and western New York dealers
Dealer no.	26	27	28	29	30	32	33		31	
Number of carloads	81	43	151	103	221	40	18		45	
Labor and management	$42.41	$39.77	$32.68	$25.76	$11.84	$40.22	$28 06	$26.58	$29.25	$26 75
Warehouse costs	5.43	0.70	5.75	5.04	2.53	9.68	......	4.27	4 52	4 28
Equipment costs	0.18	0.35	0.90	0.19	0.60	3.08	0.92	0 70	0.44	0 68
General office costs	6.07	9.44	8.30	12 14	6.23	17.84	5.42	8 51	11 19	8 68
Telephone and telegraph	0.86	3.23	3.40	0.97	1.04	4.50	1.94	1.93	1.27	1 89
Bank exchange	0.56	....	1.43	0.28	0.91	1.52	....	0 84	....	0.79
Brokerage and commissions	45.62	....	0.26	6.70	22.76	2.50	......	14 54	42 00	16.30
Linings	1.85	1.63	1.20	4.80	1.36	2.50	7.50	2.19	0.78	2.10
Sacks, tags, and twine	0.41	0.23	0.95	0.47	7 31	15.73	....	3.77	1.79	3 65
Miscellaneous	9.77	5.37	5.07	10.58	6.55	15.75	7.92	7.76	3.80	7.51
Total operating cost	$113.16	$ 60.72	$ 59.94	$ 66.93	$ 61.13	$113.32	$ 51.76	$ 71 09	$ 95.04	$ 72 63
Amount paid to growers	514 03	529.63	752.39	487.70	511.09	530.24	488.46	565.00	599.99	567.24
Total cost of potatoes to shipper	$627.19	$590.35	$812.33	$554.63	$572.22	$643.56	$540.22	$636.09	$695.03	$639.87
Gross sales	$731.13	$703.02	$935.65	$716.53	$715.42	$726.04	$613.77	$765.20	$801.36	$767.52
Claims and allowances	$ 2.78	$ 1.40	$ 17.22	$ 36.35	$ 4.52	$ 2.10	$ 2 78	$ 11.82	...	$ 11.06
Freight	128.00	127.99	121.19	130.41	131.05	122.65	65 21	125.79	$110.95	124 84
Net sales	$600.35	$573.63	$797.24	$549.77	$579.85	$601.29	$545.78	$627.59	$690 41	$631 62
Net profit	....	....	....	....	$7.63	....	$5.56	......	....	....
Net loss	$26.84	$16.72	$15.09	$4.86	....	$42.27	.....	$8 50	$4 62	$8.25

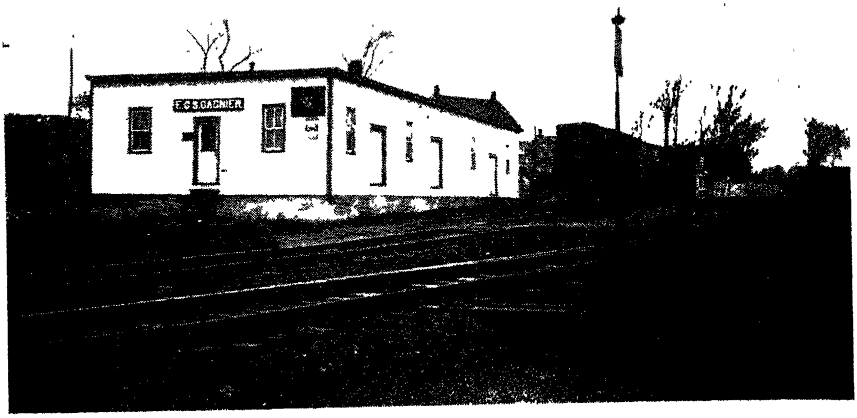

FIGURE 32. DEALER'S POTATO WAREHOUSE AT ELLENBURG STATION, CLINTON COUNTY, NEW YORK

Equipment costs.— The single-station dealers in northern New York had conservative investments in warehouses and equipment as a rule. The equipment, for the most part, consisted of hand graders of the Boggs type, about a dozen baskets and scoops or shovels, and several wooden linings for cars. Power-driven graders were not used by any of the single-station dealers.

Brokerage and commissions.— The great range in selling costs among these dealers was probably due to diversity in methods of selling. Three dealers sold all or a large proportion of their potatoes on a joint-account

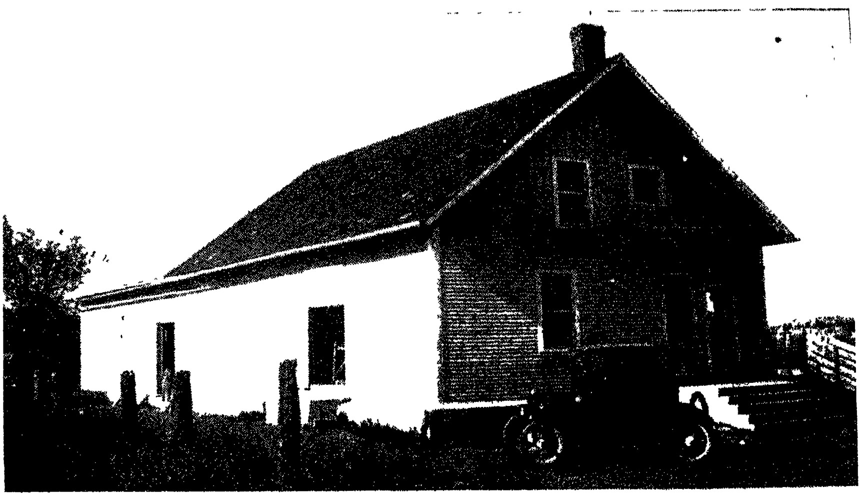

FIGURE 33. DEALER'S POTATO WAREHOUSE AT PERU, CLINTON COUNTY, NEW YORK

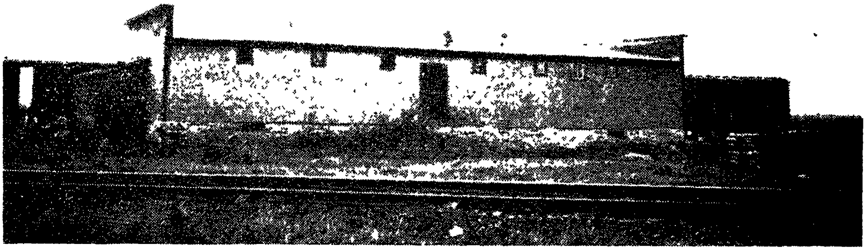

FIGURE 34. DEALER'S POTATO WAREHOUSE AT CHURUBUSCO, CLINTON COUNTY, NEW YORK

basis, and their costs per carload ranged from $22.76 to $45.62. Three sold a large proportion of their potatoes directly to firms with whom they had been dealing for years, and sold the remainder largely on commission or through brokers. Two dealers sold all of their potatoes direct. In both cases, sales were made in cities and villages within a radius of 50 or 75 miles. A considerable number of cars were sold to lumber companies to supply their logging camps. The average cost for brokerage and commissions for the whole group was $16.30 per 600-bushel carload.

Linings.— Lumber bulkheads were placed in every car of potatoes shipped in bulk, and during cold weather all box cars were lined with lumber. This would mean a heavy cost for the lumber if it could not be used again. The practice was to endeavor to have the same car returned several times for reloading, so that the bulkhead or lining cost could be spread over several cars. Lining costs averaged $2.10 a carload, with a range from 78 cents to $7.50.

FIGURE 35. DEALER'S POTATO WAREHOUSE AT CHATEAUGAY, FRANKLIN COUNTY, NEW YORK

Sacks, tags, and twine.— Expenditures for sacks, tags, and twine were relatively insignificant in the cost schedule of single-station dealers. Only two of the dealers used sacks to any extent, and the sacks used were ordinary feed bags costing about 5 cents each. There was no uniformity in size of sack or in number of bushels placed in a sack; the weights of the sacks as shipped varied from 90 to 165 pounds. The sacks were usually not sewed, as in western New York, but were tied with coarse twine. The general prevalence of the joint-account and direct methods of selling potatoes was apparently the reason for the lack of sacking. Many of these carloads went to small towns and villages, where labor costs were probably not higher than at the point of origin. The joint-account sales agents in the terminal markets generally chose to sack the potatoes to meet the preferences of their trade.

Total operating costs.— The variations in the total operating costs, ranging from \$51.76 to \$113.32, were due largely to the method of selling employed and the costs for labor and management. The average cost was \$72.63 per 600-bushel carload. The difference between the highest cost and the lowest cost was equal to about 10 cents a bushel.

Amount paid to growers.— The growers received, on the average, \$567.24 per 600-bushel carload, or approximately 94.5 cents a bushel, for the potatoes marketed through these dealers. The average price paid to the grower by the individual dealers varied from \$487.70 a carload, or 81 cents a bushel, to \$599.99 a carload, or approximately \$1 a bushel — a variation of 19 cents a bushel. If the net sales were a reliable criterion, there were wide differences in the ability of these dealers as salesmen. The net sales per carload averaged \$631.62 and ranged from \$545.78 to \$797.24. The dealer who made the highest net sales had been in the potato-shipping business for many years and knew personally a large number of the receivers of his potatoes.

Claims and allowances.— The average for claims and allowances per 600-bushel carload was \$11.06. This is approximately the same as the average claims and allowances for the entire twenty-four agencies studied during the 1921–22 season. One dealer, however, had claims averaging \$36.35 per carload. Analysis of his records showed a claim for shortage on practically every carload shipped to one large terminal market. The dealer was positive that the full invoiced weight was shipped from the station. He was uncertain as to whether the reported shortage was the result of dishonesty on the part of the wholesale receiver, or theft by potato handlers or railway employees in the terminal market. His experience illustrates one of the risks that the dealer assumes when he buys potatoes outright. In the case of the coöperative, the risk would, of course, be borne by the cooperating growers and would probably result in a reduction in price to them.

Profits and losses.— Only two of the eight single-station dealers made a profit on their potato-shipping business during the season. These two made profits, respectively, of \$7.63 and \$5.56 per 600-bushel carload, or approximately from 0.9 cent to 1.3 cents a bushel. The remaining six experienced losses ranging from \$4.62 to \$42.27 per 600-bushel carload. Since compensation for the dealer's own labor is included as a cost, the losses shown may not represent actual cash losses. As long as the loss

does not exceed the value of the dealer's labor, its amount indicates how much less than his estimate he actually received.

Results such as these may show that these dealers do not sufficiently take into account the losses they are likely to encounter through claims and allowances. Their accounting systems were, for the most part, inadequate.

Comparisons of group operating costs and returns on different bases

Bushel and hundredweight bases.— Group operating costs calculated on the bushel and the hundredweight basis, respectively, are given in tables 43 and 44.

As percentages of total operating costs.— The variation in percentages of the items of operating costs are given in table 45. Labor and management constituted about 37 per cent of the total operating costs of these single-station dealers. Brokerage and commissions amounted to about 22 per cent. Other large items were: general office costs, about 12 per cent; and miscellaneous costs, about 10 per cent.

As percentages of net sales.— For every $100 of net sales, these dealers averaged $11.51 for operating expenses and $1.75 for claims and allowances. Labor and management took, on the average, $4.24 out of every $100; brokerage and commissions, $2.58; and general office costs, $1.37. The variations in percentages of the items of cost for the eight dealers are given in table 46.

Score cards showing relative standing in efficiency.— A score card similar to those worked out for the cooperatives is shown in table 47. On the basis of costs alone, dealer no. 27 was probably the most efficient of these eight single-station dealers. His labor and management costs were very high, however, and his general office costs were well above the average. It would probably pay him to watch these items more closely. Dealer no. 30 was second in rank, on the basis of costs. His costs were all below the average, with the exception of brokerage and commissions, which were a great deal above the average.

On the basis of returns to growers, and net sales, dealer no. 28 was the most efficient and dealer no. 31 ranked second (table 48). Dealer no. 27, who ranked first in costs, ranked fifth in returns; dealer no. 30, who ranked second in costs, ranked sixth in returns. With the exception of dealers nos. 28 and 31, all of these single-station dealers were below the general average of all cooperating agencies in returns to growers and in net sales. This may indicate that attention to the selling end of the business is needed.

TABLE 43. GROUP OPERATING COSTS AND RETURNS PER BUSHEL, 8 SINGLE-STATION DEALERS, SEASON 1921–22

	Northern New York							Weighted average for northern New York dealers	Western New York	Weighted average for northern and western New York dealers
Dealer no.	26	27	28	29	30	32	33		31	
Number of bushels	48,589	25,906	90,356	61,537	132,591	24,112	10,807		26,888	
Labor and management	$0 07069	$0 06599	$0.05460	$0 04312	$0 01973	$0 06671	$0 04672	$0 04433	$0 04894	$0.04462
Warehouse costs	0 00904	0.00115	0.00960	0 00844	0 00421	0 01606		0 00711	0 00756	0 00714
Equipment costs	0 00029	0 00058	0 00149	0 00031	0 00100	0 00510	0 00153	0 00116	0 00072	0 00113
General office costs	0 01011	0 01567	0 01386	0 02031	0 01038	0.02960	0 00902	0 01418	0 01872	0 01447
Telephone and telegraph	0 00144	0 00536	0 00569	0 00162	0 00173	0.00746	0 00323	0 00322	0 00212	0 00314
Bank exchange	0 00092	. . . . .	0 00239	0 00047	0 00150	0 00252	.	0 00124		0 00131
Brokerage and commissions	0 07605	. .	0 00044	0 01121	0 03793	0 00414	. .	0 02425	0 07029	0 02719
Linings	0 00309	0 00270	0 00200	0 00819	0 00226	0.00414	0 01249	0 00365	0 00131	0 00350
Sacks, tags, and twine	0 00068	0 00037	0.00159	0.00078	0 01218	0 02609		0 00629	0 00290	0 00608
Miscellaneous	0 01632	0 00907	0.00851	0 01774	0.01097	0 02616	0 01322	0 01312	0.00641	0 01257
Total operating costs	$0 18863	$0.10089	$0 10017	$0 11219	$0 10189	$0 18798	$0 08620	$0 11855	$0 15906	$0.12115
Amount paid to growers	0.85691	0 87911	1 25737	0 81631	0 85186	0 87963	0 81358	0 94233	1 00415	0 91628
Total cost of potatoes to shipper	$1.04554	$0 98000	$1.35754	$0 92850	$0 95375	$1 06761	$0 89978	$1.06088	$1 16321	$1 00743
Gross sales	$1.21882	$1.16691	$1.56362	$1 19931	$1 19243	$1 20444	$1 02228	$1 27621	$1 34116	$1 28030
Claims and allowances	$0 00463	$0.00232	$0.02878	$0.06084	$0 00754	$0.00348	$0 00462	$0 01971		$0 01845
Freight	0 21338	0.21243	0.20252	0 21828	0 21842	0 20346	0 10860	0 20979	$0 18567	0 20825
Net sales	$1 00081	$0 95216	$1.33232	$0 02019	$0 96647	$0 99750	$0 90906	$1 04671	$1 15549	$1 05366
Net profit	. . . . .	. . . .	. . . .	.	$0.01272	. .	$0 00928			. .
Net loss	$0 04473	$0 02784	$0 02522	$0 00831		$0 07011	. .	$0 01417	$0 00772	$0 01377

TABLE 44. Group Operating Costs and Returns per Hundredweight, 8 Single-Station Dealers, Season 1921–22

	Northern New York							Weighted average for northern New York dealers	Western New York	Weighted average for northern and western New York dealers
Dealer no.	26	27	28	29	30	32	33		31	
Number of hundredweights	29,132 6	15,543 8	54,213.58	36,922 47	79,554 73	14,467 0	6,489 95		16,132 7	
Labor and management	$0.11781	$0 11001	$0.09100	$0 07186	$0 03289	$0 11119	$0 07780	$0 07391	$0 08157	$0 07347
Warehouse costs	0 01507	0 00193	0 01601	0.01407	0 00702	0 02676		0 01186	0 01260	0 01190
Equipment costs	0 00049	0 00098	0 00249	0 00052	0 00166	0 00850	0 00255	0 00193	0 00121	0 00188
General office costs	0 01685	0 02611	0 02311	0 03385	0 01730	0 04933	0 01502	0 02365	0 03120	0 02412
Telephone and telegraph	0 00240	0 00894	0 00948	0 00270	0 00289	0 01244	0.00539	0 00536	0 00353	0 00524
Bank exchange	0 00154		0.00399	0 00078	0 00251	0 00420		0 00207		0.00218
Brokerage and commissions	0 12676		0 00073	0 01868	0 06322	0 00691		0 04044	0.11716	0 04533
Linings	0 00514	0 00450	0 00333	0 01365	0 00377	0 00691	0 02080	0 00609	0 00219	0 00584
Sacks, tags, and twine	0 00114	0 00062	0 00265	0 00131	0 02030	0 04348	.	0 01049	0 00499	0 01014
Miscellaneous	0 02719	0 01488	0 01417	0 02957	0 01826	0 04359	0 02198	0 02189	0 01065	0 02092
Total operating costs	$0 31439	$0 16797	$0 16695	$0 18699	$0 16982	$0 31331	$0 14354	$0 19769	$0 26510	$0 20102
Amount paid to growers	1 42818	1 46516	2 09567	1 36050	1 41078	1 46608	1 35476	1 57121	1 67360	1 57713
Total cost of potatoes to shipper	$1 74257	$1 63313	$2 26262	$1 54749	$1 58960	$1 77939	$1 49830	$1.76890	$1 93870	$1 77815
Gross sales	$2 03136	$1 94483	$2.60604	$1 99804	$1 98710	$2 00744	$1 70229	$2 12793	$2 23528	$2 13394
Claims and allowances	$0 00771	$0 00387	$0 04797	$0 10140	$0 01256	$0 00581	$0 00770	$0 03286	.	$0 03075
Freight	0 35563	0 35405	0 33754	0 36380	0 36403	0 33911	0 18085	0 34980	$0 30946	0 34709
Net sales	$1 66802	$1 58691	$2.22053	$1 53374	$1 61081	$1 66252	$1 51374	$1 74527	$1 92582	$1 75610
Net profit					$0 02121		$0 01544			
Net loss	$0 07455	$0 04622	$0.04209	$0 01375		$0.11687		$0 02363	$0 01288	$0 02205

TABLE 45. GROUP OPERATING COSTS AS PERCENTAGES OF TOTAL OPERATING COSTS, 8 SINGLE-STATION DEALERS, SEASON 1921–22

	Northern New York							Average for northern New York dealers (per cent)	Western New York	Average for northern and western New York dealers (per cent)
Dealer no.	26	27	28	29	30	32	33		31	
Groups	Per cent								Per cent	
Labor and management	37.48	65.49	54.51	38.43	19.38	35.49	54.21	37.39	30.78	36.84
Warehouse costs	4.79	1.15	9.59	7.52	4.14	8.54	......	6.00	4.75	5.90
Equipment costs	0.16	0.58	1.50	0.28	0.98	2.71	1.78	0.98	0.46	0.93
General office costs	5.36	15.55	13.84	18.11	10.19	15.75	10.47	11.97	11.77	11.95
Telephone and telegraph	0.76	5.33	5.68	1.45	1.70	3.98	3.76	2.72	1.33	2.60
Bank exchange	0.49	......	2.39	0.42	1.48	1.34	......	1.18	....	1.08
Brokerage and commission	40.32	......	0.44	10.00	37.23	2.21	......	20.46	44.19	22.45
Linings	1.64	2.68	2.00	7.30	2.22	2.21	14.49	3.08	0.83	2.89
Sacks, tags, and twine	0.37	0.37	1.59	0.70	11.96	13.87	......	5.31	1.89	5.02
Miscellaneous	8.63	8.85	8.46	15.79	10.72	13.90	15.29	10.91	4.00	10.34

TABLE 46. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, 8 SINGLE-STATION DEALERS, SEASON 1921–22

	Northern New York							Average for northern New York dealers (per cent)	Western New York	Average for northern and western New York dealers (per cent)
Dealer no.	26	27	28	29	30	32	33		31	
Groups	Per cent								Per cent	
Labor and management	7.06	6.93	4 10	4.69	2 04	6.69	5.14	4 23	4.23	4.24
Warehouse costs	0.90	0.12	0.72	0.92	0.44	1 61	......	0.68	0.66	0.69
Equipment costs	0.03	0.06	0.11	0 03	0.10	0 51	0 17	0.11	0.06	0.11
General office costs	1.01	1.65	1.04	2.21	1.07	2.97	0.99	1.36	1.62	1.37
Telephone and telegraph	0.14	0.56	0 43	0.18	0.18	0 75	0.36	0.31	0.19	0.30
Bank exchange	0 09	......	0.18	0.05	0.16	0 25	......	0.13	......	0.12
Brokerage and commissions	7.60	......	0 03	1.22	3.93	0 42	......	2.32	6 08	2.58
Linings	0 31	0 28	0.15	0 89	0 23	0 42	1.37	0.35	0.11	0 33
Sacks, tags, and twine	0.07	0.04	0.12	0.08	1.26	2.62	......	0.60	0.26	0.58
Miscellaneous	1 63	0.94	0 64	1.92	1.13	2 62	1.45	1.24	0.55	1 19
Total operating costs	18.84	10.58	7.52	12.19	10.54	18.86	9.48	11.33	13.76	11 51
Claims and allowances	0.46	0.24	2.16	6 61	0.78	0.35	0.51	1.88	....	1.75

TABLE 47. SCORE CARD OF OPERATING COSTS, AND CLAIMS AND ALLOWANCES, 8 SINGLE-STATION DEALERS, SEASON 1921–22*

Dealer no.	26	27	28	29	30	31	32	33
Groups	Per cent of average							
Labor and management	148	139	114	90	41	102	140	98
Warehouse costs....	87	11	92	81	41	73	156	0
Equipment costs	17	33	86	18	57	42	293	88
General office costs	73	113	99	145	75	134	214	65
Telephone and telegraph	28	105	111	32	34	41	147	63
Brokerage and commissions......	511	0	3	75	255	470	28	0
Linings....	92	81	59	243	67	39	124	371
Sacks, tags, and twine.	2	1	5	2	37	9	80	0
Miscellaneous .	132	72	68	143	88	51	212	107
Claims and allowances..	25	13	156	329	41	0	19	25
Total score.	1,115	568	793	1,158	736	961	1,113	817

* The lowest score is the most efficient. Average = 1000

TABLE 48. SCORE CARD OF RETURNS, 8 SINGLE-STATION DEALERS, SEASON 1921–22*

Dealer no.	26	27	28	29	30	31	32	33
Items	Per cent of average							
Amount paid to growers.	91	93	133	86	90	106	94	86
Net sales	93	89	124	85	90	107	93	85
Total score	184	182	257	171	180	213	187	171

* The highest score is the most efficient. Average = 200.

Season 1922–23

For the 1922–23 season, records were obtained from ten single-station dealers, of whom six were included also in the 1921–22 study. Three of the ten dealers were located in Franklin County, two in Clinton County, two in Steuben County, one in Onondaga County, and one in Tioga County. All but two were engaged in other lines of work as well as in the shipping of potatoes. Six dealt in feed, fertilizer, and seed, and two of these six conducted general stores also. One dealer received and shipped a great variety of agricultural products in addition to potatoes, including hay, live poultry, eggs, and veal calves. Two dealers held agencies for well-known makes of automobiles. One engaged in horse-trading, bought and sold farm real estate, operated a farm, and shipped hay as well as potatoes. One had a large hay-shipping business, combined with a retail coal and feed business. With one exception, all of these dealers had been engaged in shipping potatoes for a number of years.

Volume of potatoes shipped

The ten single-station dealers received and shipped 21,477,622 pounds of potatoes, or 357,961 bushels, during the 1922–23 season, equivalent to 595 carloads of 600 bushels each. These potatoes actually moved to market in 448 shipments. Bulk shipments made up 10,823,002 pounds, or 50.4 per cent of the volume handled by these dealers, and 10,654,667 pounds, or 49.6 per cent, were shipped in sacks. Only 12,000 pounds were shipped by truck.

Dealers west of Malone, at points along the Rutland Railroad, stated that truck operators from cities in St. Lawrence and Jefferson Counties had made serious inroads on their business during the 1922–23 season. In some cases the business of the local shipper was practically wiped out. Trucks were reported to have come from cities as far away as Syracuse, about 190 miles distant. Apparently the trucking business is increasing and must be reckoned with in the future. As previously stated, these truck operators went directly to the farms and bought potatoes field-run, ungraded. The ability to sell their potatoes in this manner made the growers reluctant to be paid on a graded basis when they sold to the local dealers. The local dealers pointed out that the trucks operated only when there was little danger of loss from freezing. As a result, these dealers received only a small volume during the period of the year when risks from loss in transit were low, and they were called upon to receive a relatively large volume of their total business when temperatures were low, risks from loss were high, and considerable expense had to be incurred in lining cars. Under these circumstances, several of the dealers were indifferent toward the potato-shipping business. It seems possible that under such conditions the trucking of potatoes may deprive the grower of the service of the local dealer during the time of the year when trucks do not operate.

Only one carload of the 595 handled by these ten dealers was made up of potatoes of the United States no. 2 grade, or seconds. The remaining 594 carloads, or 99.83 per cent of the whole, were sold as United States no. 1, or firsts. The potatoes shipped reached a maximum of 7 States, and, on the average, went to 4 States. The average number of destinations reached per dealer was approximately 13, with an average of slightly more than 3 destinations per State.

Because of the relatively short crop of potatoes in Maine, a large proportion of the potatoes shipped by these dealers went to New England and eastern New York.

These ten single-station dealers handled 13 per cent of the volume of potatoes shipped by all of the agencies studied, and approximately 5 per cent of all up-state potatoes shipped in carloads during the 1922–23 season.

Primary and group operating costs

The items of expense per 600-bushel carload incurred in the handling and shipping of potatoes by these dealers during the 1922–23 season are given in table 49.

Labor and management.— The labor and management costs per 600-bushel carload varied even more widely among the single-station dealers

TABLE 49. PRIMARY OPERATINGS COSTS PER 600-BUSHEL CARLOAD, 10 SINGLE-STATION DEALERS, SEASON 1922–23

Dealer no.	126	127	128	129	130	131	134	135	136	137	Weighted averages		
Number of 600-bushel cars	93	26	87	60	132	41	14	31	37	74	Per car	Per bushel	Per hundredweight
Labor	$20 39354	$42 76923	$24 28046	$22 03333	$14 96969	$12 34536	$11.82499	$17 44387	$24 66216	$11 81770	$19 19071	$0 03189	$0 05316
Sacks, tags, and twine	4.68817	9.38461	7.64310	3 28333	11.36363	12 91268	18 65928	20 26580	28 89378	17 49283	11 46954	0 01906	0 03177
Rent for warehouse		1 15384	0.70701	0.75000	0.59090	0 21390				6 08108	1 13363	0 00188	0 00314
Taxes on warehouse	0 38709		1.04356	0.41666	0.45454	0.16097	2 49999	1 35322	0 15756		0 50616	0 00084	0 00140
Insurance:													
Stock	0 45806			0 61666							0 13378	0 00022	0 00037
Warehouse	0 30989		0 68965	0.23333	0.18181	0 38585	0 23785	0 69774	0 07189		0 28615	0 00047	0.00079
Employer's liability	0 30107	2.88461	0 09195		0 45454				0 45027	0 27027	0 31900	0 00058	0.00096
Fuel	6 45161	1 73076	5 78793	2 50000	2 27272	0 67414	0 49999		0 90081	1 39189	2 97398	0 00494	0 00823
Light and power			0 56172	0 25000	0.36363			0 15806		0 25675	0 22818	0 00037	0 00063
Linings	1 61290	5 38461	1 92011	5 00000	2 27272	1 45073	5 49999	2 83870	1 22972	4 60554	2 80309	0 00465	0 00776
Repairs	0.96774		0 21942	2 50000	1 13636			0 25322			0 70073	0 00116	0 10094
Supplies	0 75268		0 22712	1 46666							0 29875	0 00049	0 00082
Miscellaneous operating expenses		0.84615	0.01459		1 89393		1 85714	7 55387	12 76162		1 69011	0 00280	0 00468
Depreciation:													
Warehouse	1.72013		2,20689	2 50000	1 13636	1 82926	5 34285	6 91935	0 44594		1 73579	0 00288	0 00480
Equipment	0.10752	0.46153	0 68965	0.23333	0.56818	0 30487	0 42857	2 61870	0 78375		0 50366	0 00083	0 00139
Officers' salaries	21 50537		29 31034		8 07575						9 13865	0 01508	0 02514
Manager's salary		13 84615		11 00000		30 73170	8 35714	10 80000	16 21621	13 51351	7 28033	0 01210	0 02016
Office salaries	1.61290			6 16666	3 27272			4 00000			1 80810	0 00300	0 00500
Travel			0.36390		1.89393	0 05268		2 52838			0 60873	0 00101	0 00168
Office supplies	0.53763	0 38461	0.13402	0.16666	0.11363	0 19219			0 44594	0 20270	0 22863	0 00038	0 00063
Telephone and telegraph	0 75268	3.65999	2 92413	0 83333	1.74242	1 93439	1 78571	3 87806	1 12594	2 29878	1 90900	0 00317	0 00528
Inspection				0 13333						2 32432	0 30252	0 00050	0 00083
Office rent	0 96774	2.69230		0 83333		0.94243				2 02702	0 66998	0.00111	0 00185
Brokerage and commissions	89 21204			8 39666	18 44689	57 66000	0 71428	7 26677	4 05405	8 64864	24 57955	0 04085	0 06809
Advertising and publicity			0.02298		0 30303						0 07058	0 00011	0 00019
Market service		0.23076			0 07575		1 07142				0.05210	0 00008	0 00014
Interest on borrowed money	0.96771	5 76923		5 00000	2 27272			2.94993			1 56341	0 00260	0 00433
Interest on investment	1 54711	0.09692	2.71000	1 30200	1 79363	5 47487	6 31999	7 23032	1 80405		2 18641	0 00363	0 00605
Miscellaneous office expenses													
Depreciation on furniture and fixtures	0.23151		0.06678		0.06060			0 17193	0 02702		0 08613	0 00014	0.00023
Bad debts			9 19540		3.78787			10.91584		0 14189	2 77280	0 00460	0 00768
Demurrage	0.06451	4 99999	0.64367	0.83333	0 75757	1 65853					0 68907	0 00114	0 00190
Bank exchange	0 41191		4.68747	0.33650	1.51515		0 37142	0 21451	0 55405	0 86027	1.28168	0 00213	0 00355
Freight, express, and drayage*	0.35615		1.02218			1 47658				0 06756	0 31532	0 00052	0 00087
Total operating costs	$156.32462	$96.29529	$97.16403	$76.78510	$81.77067	$130 43113	$65 47061	$110 38733	$94.58476	$72 00075	$99 84855	$0 16581	$0 27644

* See first footnote to table 22, page 56.

in 1922–23 than in the previous season (table 50). The average costs were $29.50 per carload and the range was from $16 to $52.58. This greater variation may be due to the fact that, with one exception, all of the dealers handled fewer carloads during the second season; in several cases the volume was approximately 50 per cent of that handled during the 1921–22 season. It is a curious fact that while the production of potatoes in New York as a whole was larger in 1922 than in 1921, the production in the areas studied in 1922 was actually below that of the preceding year. If, then, expecting a normal crop, a dealer had hired labor for the winter, it is possible to understand the relatively large outlay for labor and management during the season. Dealers who attempted to maintain their working gang under such conditions almost inevitably had high costs per car. The trucking of potatoes in the northern area may have had some influence on this factor. The costs for labor and management were approximately $6 less per car in western than in northern New York.

Warehouse costs.— The average warehouse costs per carload handled during the 1922–23 season were about 26 per cent higher than in the previous season. This was probably a result of the reduction in the volume handled. The warehouse costs averaged $5.71 per carload, with a range from $1.15 to $13.30. The average investment was $1916.60 per warehouse, or $32.27 per carload handled. This compares with an average investment of $3091.98 per warehouse, or $56.22 per carload, for the cooperatives, and $1446.62 per warehouse, or $47.62 per carload, for the many-station dealers (table 15, page 36).

Brokerage and commissions.— Two of these dealers sold all of their potatoes direct, largely to near-by cities and villages. Two sold the bulk of their potatoes on the joint-account basis and had very high selling costs, $57.66 and $89.21 per carload, respectively. The average selling cost for these ten dealers was $24.58 per carload, with a range from 72 cents to $89.21.

Sacks, tags, and twine.— The expenditures of the northern New York dealers for sacks were relatively low, since they shipped from 45 to 89 per cent of their potatoes in bulk. Where sacks were used, they consisted largely of secondhand feed and even fertilizer sacks. These sacks were shipped with contents varying from 90 pounds to 165 pounds, and were usually tied with heavy twine and not sewed. One of the dealers, who shipped some of his potatoes south and west, used new 150-pound sacks. The western New York dealers commonly used sacks. Two of them shipped no potatoes in bulk, and the remaining three shipped from 43 to 57 per cent of their potatoes in sacks. All of these dealers used new 150-pound sacks, which were carefully sewed before shipping.

Linings.— The care taken in lining cars as protection against damage of all kinds varied considerably. The average cost per carload was $2.80, and the range was from $1.23 to $5.50. Oddly enough, the northern New York dealers spent comparatively less for car linings than did the dealers in western New York. The relative difference in winter temperatures would lead one to expect the reverse. The two dealers who had the highest cost per carload for linings were the only two in this group who had no claims for allowances and deductions.

TABLE 50. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 10 SINGLE-STATION DEALERS, SEASON 1922–23

	Northern New York					Average for northern New York dealers	Western New York					Average for western New York dealers	Average for northern and western New York dealers
Dealer no.	126	127	128	129	130		131	134	135	136	137		
Number of carloads	93	26	87	60	132		41	14	31	37	74		
Labor and management	$31.45	$52.58	$46.36	$27.53	$19.46	$31.52	$35.39	$16.00	$22.84	$33.22	$18.84	$25.42	$29.50
Warehouse costs	4.66	1.15	7.10	7.68	4.57	5.39	4.65	13.06	13.30	1.77	5.41	6.35	5.71
Equipment costs	0.15	0.56	0.90	0.26	0.97	0.63	0.46	2.53	3.33	1.47	0.68	1.33	0.86
General office costs	15.31	16.00	8.99	17.83	10.46	12.74	12.11	6.34	15.26	8.96	9.66	10.68	12.06
Telephone and telegraph	0.75	3.66	2.92	0.83	1.74	1.76	1.94	1.79	3.88	1.13	2.30	2.21	1.91
Bank exchange	0.41	......	4.69	0.34	1.52	1.67	. .	0.37	0.21	0.55	0.86	0.49	1.28
Brokerage and commissions	89.21	....	.	8.40	18.45	28.23	57.66	0.72	7.27	4.05	8.65	17.20	24.58
Linings	1.61	5.38	1.92	5.00	2.27	2.66	1.45	5.50	2.84	1.23	4.61	3.10	2.80
Sacks, tags, and twine	4.69	9.38	7.64	3.28	11.36	7.64	12.91	18.66	20.27	28.89	17.49	19.20	11.47
Miscellaneous	8.08	7.58	16.64	5.63	10.97	10.51	3.86	0.50	21.19	13.31	3.50	7.99	9.67
Total operating costs	$156.32	$ 96.29	$ 97.16	$ 76.78	$ 81.77	$102.75	$130.43	$ 65.47	$110.39	$ 94.58	$ 72.00	$ 93.97	$ 99.84
Amount paid to growers	328.01	393.75	377.98	301.17	332.21	340.57	437.28	298.53	277.12	329.77	300.45	330.63	337.28
Total cost of potatoes to shipper	$484.33	$490.04	$475.14	$377.95	$413.98	$443.32	$567.71	$364.00	$387.51	$424.35	$372.45	$424.60	$437.12
Gross sales	$612.88	$550.91	$605.84	$514.44	$575.92	$580.20	$688.83	$458.57	$496.35	$536.60	$473.23	$532.60	$564.44
Claims and allowances	$ 1.61	....	$ 11.55	$ 4.86	$ 12.12	$ 7.65	. .	$ 0.07	$ 13.09	$ 4.05	$ 1.15	$ 3.26	$ 6.20
Freight	108.69	$102.92	108.77	115.88	119.51	113.00	$102.21	71.90	114.87	120.59	101.68	105.30	110.45
Net sales	$502.58	$447.99	$485.52	$393.70	$444.29	$459.54	$586.62	$386.60	$368.39	$411.96	$370.40	$424.04	$447.79
Net profit	$18.25	.....	$10.38	$15.75	$30.31	$16.22	$18.91	$22.60	. .		.	. .	$10.67
Net loss	. . .	$42.05	.....	......	. .	. .	. .	. . .	$19.12	$12.39	$2.05	$0.56	. .

Total operating costs.— The cost of handling a 600-bushel carload of potatoes, for these ten dealers, averaged $99.84, with a range from $65.47 to $156.32. This compares with an average cost of $72.63, and a range from $51.76 to $113.32, for the eight single-station dealers during the 1921-22 season. The average cost in 1922–23 for the five northern New York dealers was $102.75, and for the five western New York dealers $93.97. The outstanding differences were in the costs for labor and management, brokerage and commissions, and sacks. The cost for sacks, tags, and twine for the northern New York dealers averaged $7.64 per carload. Western New York dealers expended an average of $19.20 per carload for sacks. The difference between the highest and the lowest operating cost for these dealers in this season was $90.85 per carload, or approximately 15 cents per bushel.

Amount paid to growers.— The amount paid to growers for their potatoes by these ten dealers averaged $337.28 per carload of 600 bushels, and ranged from $277.12 to $437.28, a difference of about 27 cents a bushel. The highest price paid, however, was for exceptionally good stock which went to points in Pennsylvania for use as seed. The average price paid to growers in western New York was approximately 55 cents a bushel, and to growers in northern New York 57 cents a bushel. The average net sales of the two dealers who sold on the joint-account basis were respectively $502.58 and $586.62 per carload; the average for all the ten dealers was but $447.79.

Claims and allowances.— Claims and allowances were about twice as high for the northern New York dealers as for the western New York dealers, the respective figures being $7.65 and $3.26 per carload. This may have been due to lower temperatures or to many other causes. The northern New York dealers expended a little less for car linings, and probably did not grade so well as did their competitors in western New York. The average amount of claims and allowances per carload was $6.20, with a range from 0 to $13.09.

Profits and losses.— Six of the ten single-station dealers made profits ranging from $10.38 to $30.31 per carload; four dealers had losses ranging from 56 cents to $42.05 per carload. The average profit of the ten dealers was $10.67 per carload, or approximately 1.8 cents per bushel. Four of the five dealers in northern New York made a profit, while only two of the five in western New York were so fortunate. The dealer who made the largest profit was the one with the largest and most diversified business; his costs were relatively low, since there were so many opportunities for profitable employment in his business that little time was lost.

Comparisons of group operating costs and returns on different bases

Bushel and hundredweight bases.— Costs and returns, calculated on the bushel and the hundredweight basis for the ten dealers, are given n tables 51 and 52.

As percentages of total operating costs.— Labor and management made up approximately 30 per cent of the cost of handling potatoes by these ten dealers (table 53). This percentage varied with the individual dealers, from 20 to about 55 per cent. Warehouse costs were nearly 6 per cent of the total. General administration expenses amounted to slightly over

TABLE 51. GROUP OPERATING COSTS AND RETURNS PER BUSHEL, 10 SINGLE-STATION DEALERS, SEASON 1922–23

	Northern New York					Weighted average for northern New York dealers	Western New York					Weighted average for western New York dealers	Weighted average for northern and western New York dealers
Dealer no.	126	127	128	129	130		131	134	135	136	137		
Number of bushels	55,944	15,876	52,323	36,101	79,129		24,475	8,476	18,883	22,120	44,534		
Labor and management	$0.05227	$0.08610	$0.07707	$0.04575	$0.03245	$0.05240	$0.05920	$0.02612	$0.03750	$0.05556	$0.03131	$0.04221	$0.04903
Warehouse costs	0.00774	0.00188	0.01180	0.01275	0.00762	0.00895	0.00778	0.02132	0.02184	0.00296	0.00898	0.01055	0.00948
Equipment costs	0.00024	0.00091	0.00150	0.00043	0.00162	0.00104	0.00076	0.00113	0.00516	0.00245	0.00112	0.00220	0.00143
General office costs	0.02545	0.02620	0.01495	0.02963	0.01744	0.02119	0.02028	0.01035	0.01704	0.01498	0.01605	0.01774	0.02005
Telephone and telegraph	0.00125	0.00599	0.00486	0.00138	0.00290	0.00292	0.00321	0.00291	0.00636	0.00188	0.00381	0.00367	0.00317
Bank exchange	0.00068	....	0.00779	0.00055	0.00252	0.00278	.	0.00060	0.00035	0.00092	0.00142	0.00080	0.00213
Brokerage and commissions	0.14830	.....	....	0.01395	0.03077	0.04693	0.09650	0.00116	0.01192	0.00678	0.01437	0.02869	0.04085
Linings	0.00268	0.00881	0.00319	0.00831	0.00379	0.00441	0.00243	0.00897	0.00106	0.00205	0.00765	0.00515	0.00465
Sacks, tags, and twine	0.00779	0.01536	0.01270	0.00545	0.01895	0.01270	0.02163	0.03046	0.03327	0.04833	0.02906	0.03189	0.01906
Miscellaneous	0.01347	0.01245	0.02769	0.00941	0.01834	0.01752	0.00640	0.00085	0.03182	0.02230	0.00586	0.01323	0.01611
Total operating costs	$0.25987	$0.15770	$0.16155	$0.12761	$0.13640	$0.17084	$0.21819	$0.10687	$0.18122	$0.15821	$0.11963	$0.15613	$0.16596
Amount paid to growers	0.54526	0.64484	0.62847	0.50054	0.55416	0.56625	0.73252	0.48733	0.45495	0.55160	0.49924	0.54924	0.56062
Total cost of potatoes to shipper	$0.80513	$0.80254	$0.79002	$0.62815	$0.69056	$0.73709	$0.95101	$0.59420	$0.63617	$0.70981	$0.61887	$0.70537	$0.72658
Gross sales	$1.01884	$0.90222	$1.00735	$0.85500	$0.96072	$0.96468	$1.15391	$0.74860	$0.81485	$0.89757	$0.78631	$0.88476	$0.93820
Claims and allowances	$0.00268	....	$0.01920	$0.00808	$0.02022	$0.01272	...	$0.00011	$0.02149	$0.00678	$0.00190	$0.00541	$0.01030
Freight	0.18067	$0.16855	0.18085	0.19258	0.19935	0.18788	$0.17122	0.11737	0.18858	0.20171	0.16806	0.17493	0.18359
Net sales	$0.83549	$0.73367	$0.80730	$0.65434	$0.74115	$0.76408	$0.98269	$0.63112	$0.60478	$0.68908	$0.61548	$0.70442	$0.74431
Net profit	$0.03036	....	$0.01728	$0.02619	$0.05059	$0.02699	$0.03168	$0.03692	. .	.	...	...	$0.01773
Net loss	.....	$0.06887	....	....	....	....	.....	.. .	$0.03139	$0.02073	$0.00339	$0.00095	....

TABLE 52. GROUP OPERATING COSTS AND RETURNS PER HUNDREDWEIGHT, 10 SINGLE-STATION DEALERS, SEASON 1922–23

	Northern New York					Weighted average for northern New York dealers	Western New York					Weighted average for western New York dealers	Weighted average for northern and western New York dealers
Dealer no.	126	127	128	129	130		131	134	135	136	137		
Number of hundredweights	33,566.53	9,525 6	31,393.65	21,660.52	47,477.40		14,684.90	5,145.38	11,329 50	13,272.19	26,720.62		
Labor and management	$0.08712	$0 14350	$0.12845	$0.07626	$0.05410	$0 08734	$0 09881	$0 04354	$0 06250	$0 09261	$0 05218	$0 07036	$0 08172
Warehouse costs	0 01290	0.00314	0.01967	0.02125	0.01270	0.01492	0 01297	0 03554	0 03640	0 00493	0 01196	0.01758	0 01580
Equipment costs	0.00041	0.00152	0.00250	0 00072	0 00270	0.00174	0 00128	0 00688	0 00911	0 00408	0 00187	0 00367	0 00238
General office costs	0 04241	0.04367	0.02491	0.04939	0.02907	0.03531	0 03381	0 01725	0 04174	0 02497	0 02675	0 02958	0 03341
Telephone and telegraph	0 00208	0 00998	0 00810	0 00230	0 00484	0 00487	0 00540	0 00485	0 01061	0 00313	0 00636	0 00613	0 00528
Bank exchange	0.00114		0 01299	0 00093	0.00421	0.00464		0 00101	0.00058	0 00154	0 00238	0 00134	0 00355
Brokerage and commissions	0 24717	. . .	. .	0 02325	0.05128	0 07822	0 16098	0 00194	0 01988	0 01130	0 02395	0 04763	0 06809
Linings	0.00446	0 01469	0 00532	0.01385	0.00631	0 00735	0 00405	0 01496	0 00776	0 00342	0 01[illegible]75	0 00858	0 00776
Sacks, tags, and twine	0 01298	0 02561	0.02118	0 00909	0 03159	0.02118	0 03605	0.05076	0 05545	0 08054	0 01814	0 05315	0 03177
Miscellaneous	0 02244	0 02072	0 04614	0 01565	0 03054	0 02917	0 01081	0 00140	0 05801	0.03716	0 00975	0 02218	0 02685
Total operating costs	$0 43311	$0 26283	$0.26926	$0 21269	$0 22734	$0 28474	$0 36416	$0 17813	$0 30204	$0 26368	$0 19939	$0 26020	$0 27661
Amount paid to growers	0 90877	1.07473	1 04746	0 83424	0 92361	0 94376	1 22087	0 81226	0 75827	0 91933	0 83206	0 91540	0 93436
Total cost of potatoes to shipper	$1 34188	$1.33756	$1 31672	$1 04693	$1 15095	$1 22850	$1.58503	$0 99039	$1 06031	$1 18301	$1 03145	$1 17560	$1 21097
Gross sales	$1 69807	$1 50371	$1 67893	$1 42502	$1 60121	$1 60780	$1 92321	$1 24772	$1 35813	$1 49593	$1 31056	$1 47461	$1 56367
Claims and allowances	$0 00446	. . .	$0 03200	$0 01347	$0.03370	$0 02121		$0 00019	$0 03582	$0 01130	$0 00318	$0 00902	$0 01717
Freight	0.30112	$0.28092	0 30142	0 32098	0 33225	0 31313	$0 28537	0 19564	0 31431	0 33618	0 28160	0 29155	0 30598
Net sales	$1 39249	$1 22279	$1.34551	$1.09057	$1 23520	$1 27346	$1 63784	$1 05189	$1 00800	$1 14845	$1 02578	$1 17404	$1 24052
Net profit	$0 05061	.	$0 02879	$0.04364	$0.08431	$0 04496	$0 05281	$0.06150				. . . . .	$0 02955
Net loss	. . . .	$0.11477	. . .	. . . .	. . .	. . . . . .	. . .	. .	$0 05231	$0 03456	$0 00567	$0 00156	. . . .

TABLE 53. GROUP OPERATING COSTS AS PERCENTAGES OF TOTAL OPERATING COSTS, 10 SINGLE-STATION DEALERS, SEASON 1922–23

	Northern New York					Average for northern New York dealers (per cent)	Western New York					Average for western New York dealers (per cent)	Average for northern and western New York dealers (per cent)
Dealer no.	126	127	128	129	130		131	134	135	136	137		
Groups	Per cent						Per cent						
Labor and management	20.12	54.60	47.71	35.85	23.80	30.68	27.14	24.44	20.70	35.12	26.17	27.04	29.55
Warehouse costs	2.98	1.20	7.31	10.00	5.58	5.24	3.56	19.95	12.05	1.87	7.51	6.76	5.72
Equipment costs	0.10	0.58	0.93	0.34	1.19	0.62	0.35	3.87	3.02	1.54	0.94	1.41	0.86
General office costs	9.79	16.62	9.25	23.22	12.79	12.40	9.29	9.69	13.82	9.47	13.42	11.37	12.08
Telephone and telegraph	0.48	3.80	3.01	1.09	2.13	1.71	1.48	2.73	3.51	1.19	3.19	2.36	1.91
Bank exchange	0.27	....	4.82	0.44	1.85	1.63	...	0.57	0.20	0.59	1.19	0.52	1.28
Brokerage and commissions	57.06	......	......	10.93	22.56	27.47	44.21	1.09	6.58	4.29	12.01	18.31	24.62
Linings	1.03	5.59	1.98	6.51	2.78	2.58	1.11	8.40	2.57	1.30	6.40	3.30	2.81
Sacks, tags, and twine	3.00	9.75	7.87	4.28	13.90	7.44	9.90	28.50	18.36	30.55	24.30	20.43	11.48
Miscellaneous	5.17	7.86	17.12	7.34	13.42	10.23	2.96	0.76	19.19	14.08	4.87	8.50	9.69

TABLE 54. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, 10 SINGLE-STATION DEALERS, SEASON 1922–23

	Northern New York					Average for northern New York dealers (per cent)	Western New York					Average for western New York dealers (per cent)	Average for northern and western New York dealers (per cent)
Dealer no.	126	127	128	129	130		131	134	135	136	137		
Groups	Per cent						Per cent						
Labor and management	6.26	11.74	9.55	7.00	4.38	6.86	6.03	4.14	6.20	8.06	5.09	6.00	6.59
Warehouse costs	0.93	0.26	1.46	1.95	1.03	1.17	0.79	3.38	3.61	0.43	1.46	1.50	1.27
Equipment costs	0.03	0.12	0.19	0.07	0.22	0.14	0.08	0.65	0.91	0.36	0.18	0.31	0.19
General office costs	3.05	3.57	1.85	4.53	2.35	2.77	2.06	1.64	4.14	2.18	2.61	2.52	2.69
Telephone and telegraph	0.15	0.82	0.60	0.21	0.39	0.38	0.33	0.46	1.05	0.27	0.62	0.52	0.43
Bank exchange	0.08	...	0.96	0.09	0.34	0.37	..	0.10	0.06	0.14	0.23	0.11	0.29
Brokerage and commissions	17.75	....	...	2.13	4.15	6.14	9.83	0.18	1.97	0.98	2.34	4.05	5.49
Linings	0.32	1.20	0.40	1.26	0.51	0.58	0.25	1.42	0.77	0.30	1.24	0.73	0.63
Sacks, tags, and twine	0.93	2.09	1.57	0.83	2.56	1.66	2.20	4.83	5.50	7.01	4.72	4.53	2.56
Miscellaneous	1.60	1.69	3.43	1.43	2.47	2.29	0.66	0.13	5.75	3.23	0.95	1.88	2.16
Total operating costs	31.10	21.49	20.01	19.50	18.40	22.36	22.23	16.93	29.96	22.96	19.44	22.16	22.30
Claims and allowances	0.32	...	2.38	1.24	2.73	1.66		0.02	3.55	0.98	0.31	0.77	1.38

12 per cent. Brokerage and commissions made up almost as large a share of the cost as did labor, averaging approximately 25 per cent and ranging from 57 per cent to 0. Sacks, tags, and twine averaged about 11.5 per cent of the total, and ranged from as low as 3 per cent to as high as 30 per cent, being much higher in western than in northern New York. These percentages do not vary greatly from those for the 1921–22 season.

As percentages of net sales.— On the average, the single-station dealers paid $22.30 for operating expenses from every $100 of net sales (table 54). This was made up as follows: $6.59 for labor and management; $1.27 for warehouse costs; 19 cents for equipment costs; $2.69 for general administration expenses; 43 cents for telephone and telegraph bills; 29 cents for bank exchange; $5.49 for selling costs; 63 cents for car linings; $2.56 for sacks, tags, and twine; and $2.16 for miscellaneous expenses. For every $100 of net sales they also made allowances averaging $1.38.

Score cards showing relative standing in efficiency.— A score card on costs and allowances similar to those previously used in this study is shown in table 55. On the basis of costs alone, dealer no. 137 was rated the most efficient. The expenditures for linings were very much above the average. In the matter of returns, however (table 56), dealer no. 137 was next to the lowest. This may indicate that more attention to the selling end of this business would be desirable. Dealer no. 127 was third in costs and second in returns. The weak points in this dealer's business were probably the high labor and management costs, general office costs, and costs for linings. Dealer no. 131 ranked first in returns but eighth in costs. Extremely high costs for brokerage and commissions, and above-average costs for labor and management and for general office expenses, were probably the weak spots in his business.

TABLE 55. SCORE CARD OF OPERATING COSTS, AND CLAIMS AND ALLOWANCES, 10 SINGLE-STATION DEALERS, SEASON 1922–23*

Dealer no.	126	127	128	129	130	131	134	135	136	137
Groups	Per cent of average									
Labor and management	112	188	166	98	69	126	57	82	119	67
Warehouse costs	73	18	142	120	71	72	203	207	28	84
Equipment costs	12	44	71	20	76	36	199	262	116	54
General office costs	149	156	88	174	102	118	62	149	87	94
Telephone and telegraph	28	135	107	31	64	71	66	143	42	85
Brokerage and commissions	783	......	......	74	162	506	6	64	36	76
Linings	78	261	93	243	110	70	267	138	60	224
Sacks, tags, and twine	21	41	33	14	50	57	82	89	126	77
Miscellaneous	103	97	212	72	140	49	6	270	170	45
Claims and allowances	22	......	158	67	166	......	1	180	56	16
Total score	1,381	940	1,070	913	1,010	1,105	949	1,584	840	822

* The lowest score is the most efficient. Average = 1000.

TABLE 56. SCORE CARD OF RETURNS, 10 SINGLE-STATION DEALERS, SEASON 1922–23*

Dealer no.	126	127	128	129	130	131	134	135	136	137
Groups	Per cent of average									
Amount paid to growers	102	122	117	93	103	135	93	86	102	93
Net sales	123	108	117	95	107	141	93	89	99	89
Total score	225	230	234	188	210	276	186	175	201	182

* The highest score in the most efficient. Average = 200.

MANY-STATION DEALERS

Season 1921–22

The records of nine many-station dealers were studied for the 1921–22 season. One of these dealers had his home office in the central part of Steuben County. He bought potatoes on one basis or another, through the medium of employees, at thirty-three shipping points in nine counties in New York. He handled about 27 carloads of potatoes per station (table 57).

This example may serve to illustrate the differences between cooperative associations, single-station dealers, and many-station dealers. The first two types of shipping agencies operate at one shipping point only. Theoretically, at least, these two types should be more efficient than the many-station dealers because they are able, on the average, to obtain a larger volume of potatoes per station (table 14) and because they have all of their business under immediate supervision. During the 1921-22 season, the cooperatives that had warehouses averaged 78 carloads per warehouse, the single-station dealers 98 carloads, and the many-station dealers 39 carloads. Operating from two to twenty-one warehouses, the many-station dealers found it necessary to spend considerable time and money on travel for purposes of supervision. These dealers also bought odd carloads at points where the total volume shipped would probably have been too small to support a cooperative or a single-station dealer.

TABLE 57. COUNTY OF ORIGIN, NUMBER OF SHIPPING STATIONS IN EACH COUNTY, AND NUMBER OF CARS OF POTATOES SHIPPED FROM EACH COUNTY BY A MANY-STATION DEALER, SEASON 1921–22

County of origin	Number of shipping stations in each county	Number of actual carloads of potatoes shipped from each county	Average number of actual carloads per station
Steuben	8	310	39
Allegany	2	143	71
Otsego	10	160	16
Schoharie	1	6	6
Broome	1	45	45
Tioga	4	52	13
Franklin	4	132	33
Schuyler	1	19	19
Livingston	2	7	3
Total	33	874	27

The nine dealers who furnished data for this study for the year 1921–22 had a total of 203 loading stations, at which they loaded 4453 carloads of 600 bushels each, or an average of 22 carloads per station (table 58). Five of the dealers had headquarters in Steuben County, three in Allegany County, and one in Clinton County. All of them dealt more or less in

TABLE 58. NUMBER OF LOADING STATIONS AND VOLUME PER STATION, 9 MANY-STATION DEALERS, SEASON 1921–22

Dealer no.	Number of loading stations	Number of 600-bushel carloads shipped	Average number of 600-bushel carloads per station
51	15	473	32
52	8	68	8
53	19	504	27
54	49	898	18
55	5	174	35
56	33	887	17
57	24	417	17
58	28	521	19
60	22	511	23
Total	203	4,453	22

other products besides potatoes (figures 36 to 38). The diversity of interest which engaged the attention of these dealers is set forth in table 59. In this table it is shown that these dealers did not confine their business to the selling of one commodity alone, but made an effort to deal in all of the products raised in their region. Several of the dealers stated that only by handling all possible products could a reasonably profitable business be maintained. All of the dealers had been engaged in the produce business

TABLE 59. AGRICULTURAL PRODUCTS SHIPPED, AND OTHER ENTERPRISES ENGAGED IN, 9 MANY-STATION DEALERS, SEASON 1921–22

Dealer	Agricultural products shipped	Other enterprises engaged in by dealer	Per cent of total business that potatoes constituted
A	Potatoes, rye, buckwheat, wheat	Lime and fertilizer during summer	87.0
B	Potatoes, apples	Farm machinery, farming, feed	66.0
C	Potatoes, hay, cabbage, buckwheat, wheat, carrots, beans, turnips, straw	Feed, farm machinery, farming	68.0
D	Potatoes, hay, wheat, rye, beans, straw, grapes, pears, cabbage	......	62.0
E	Potatoes	Tile manufacture	50.0
F	Potatoes, hay, grapes, wheat, cabbage, buckwheat	......	92.4
G	Potatoes, hay, cabbage	Produce business in the South during summer	99.2
H	Potatoes, grapes, hay, cabbage, buckwheat	......	98.5
I	Potatoes, beans, hay, wool, straw, wheat, rye, buckwheat	Feed, fertilizer, seed	25.0

Figure 36. Office building and feed store of a potato dealer in Allegany County, western New York

for a considerable number of years, either as operators or as employees. Their practices are probably the result of hard-won experience.

Volume of potatoes shipped

During the 1921–22 season, these nine many-station dealers received and shipped 160,317,325 pounds of potatoes, or 2,671,957 bushels, equivalent to 4453 carloads of 600 bushels each. These potatoes actually moved to market in 4359 shipments. Of the total volume shipped, 143,756,631 pounds, or 89.7 per cent, were shipped in sacks, and 16,560,694 pounds, or 10.3 per cent, in bulk. Three dealers shipped from 15 to 23 per cent of the volume handled, in bulk; none of the others shipped more than 8 per cent in bulk, and two dealers shipped their entire volume in sacks.

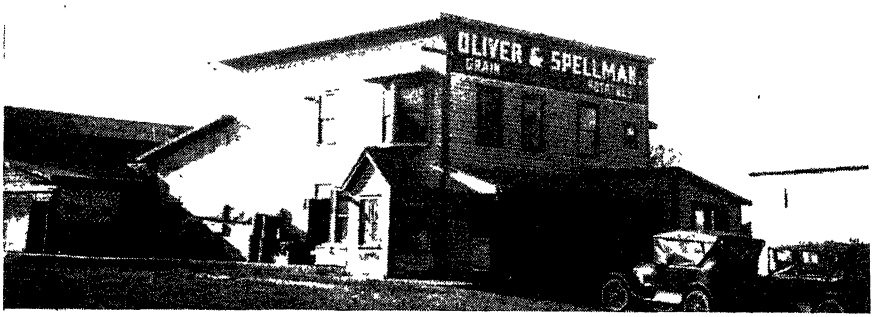

Figure 37. Office building and feed store of a dealer in Franklin County, northern New York

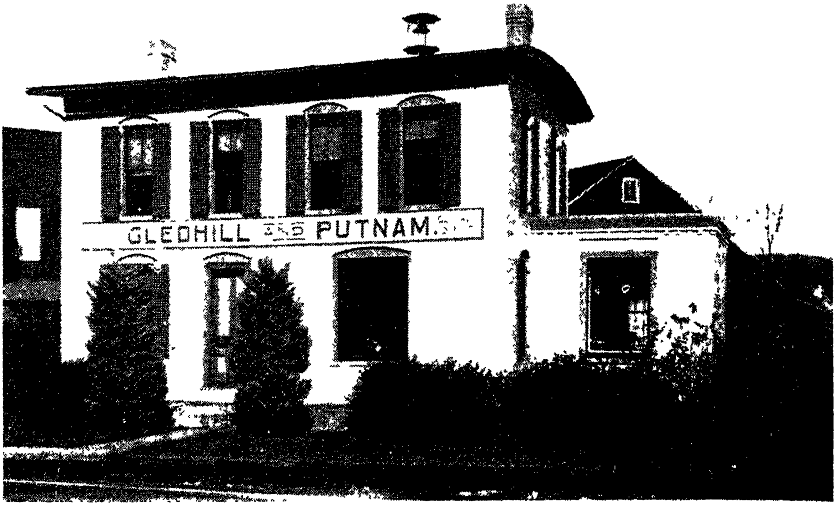

FIGURE 38. HEADQUARTERS OF A MANY-STATION DEALER IN STEUBEN COUNTY, WESTERN NEW YORK

These dealers shipped two grades of potatoes during the 1921–22 season. Of the total volume, 5,663,050 pounds, or about 157 carloads of 600 bushels each, were sold as United States no. 2 grade. The remainder, comprising 96.47 per cent of the total, were shipped as United States no. 1 grade.

The potatoes shipped by these dealers reached a maximum of 18 States, and, on the average, went to 11 States. The shipments by one dealer went to 148 destinations in 17 States and the District of Columbia. The average number of destinations reached by these dealers was 75. An average of 11 States was reached per dealer, and shipments averaged approximately 35 carloads per State.

Several of the dealers located in northern Steuben, Wyoming, and Allegany Counties reported some competition from truck operators. Approximately 2218 bushels of potatoes, or the equivalent of slightly less than four standard carloads, were sold to truck operators. These truckmen usually came from Rochester or that vicinity, with loads of apples or peaches for disposal in the villages and towns of the southern tier of counties. They frequently took return loads of potatoes for sale in Rochester or the neighboring towns. Trucking potatoes is apparently on the increase in the Steuben area as well as in northern New York, and must be considered by potato shippers.

These nine many-station dealers handled 76 per cent of the volume of potatoes shipped by all the agencies studied, and approximately 31.5 per cent of all up-state potatoes shipped in carloads during the 1921–22 season.

Methods of operation

All of the many-station dealers studied during this season were located in small towns or villages in the potato-producing areas. They obtained the volume of business either by hiring loaders (men who bought and

loaded potatoes) at the various stations, or by purchasing from other dealers potatoes loaded on track. Approximately 98,271 bushels, the equivalent of 164 standard carloads, were bought outright, loaded on track. This was about 4 per cent of the total volume handled. Such transactions were common where so few carloads were shipped annually that the loader did not keep well informed on market conditions. He preferred to sell to a many-station dealer and get a certain profit, rather than trust to luck in a larger market with which he was unfamiliar and had no established trade connections. The many-station dealer, on the other hand, hoped, through superior knowledge of the market, to sell the carload to advantage, and at the same time cut down his overhead expenses per unit by the increase in volume.

Methods of hiring loaders varied with each dealer, but, with minor variations in details, loaders were usually hired in one of three ways: (1) on a straight salary regardless of volume; (2) on an agreed commission per bushel or per hundredweight loaded; or (3) on a joint-account basis.

Salary basis.— Approximately 578,487 bushels of potatoes, or 22 per cent of the total volume handled, were loaded on the salary basis. Practically all of the potatoes received at the home stations of the many-station dealers were graded and loaded by labor hired on salary for that purpose. Several of the many-station dealers hired a few loaders at outside points on the salary basis. Loaders who were hired on this basis were usually men who had had considerable experience in the potato business and in whom the dealer had confidence. At stations where potatoes were loaded on the salary basis, the dealer paid all operating expenses. It was difficult to separate all of the central-office overhead expenses from the salary paid for loading potatoes, but, as nearly as can be ascertained the cost of handling 578,487 bushels of potatoes on the salary basis was approximately 6.1 cents a bushel.

Commission basis.— Of the total volume, about 1403 standard carloads, approximately 31 per cent, were loaded on the commission basis. Loaders engaged on this basis were commonly paid at an agreed rate per bushel or per hundredweight loaded. There was some variation in the rates paid, although the compensation for this kind of work seems to have been fairly well standardized. The average commission for loading 841,827 bushels was 6.52 cents a bushel, with a range from 5.32 to 7.71 cents. The agreements between dealer and loader varied greatly. A few loaders furnished a shed or a warehouse without charge; others were paid a certain rent for the warehouse; and many had no warehouse. About all that can be said of these loading agreements is that they varied according to the bargaining abilities of loader and dealer.

It should not be assumed that the commission paid to the loader represented clear gain. The dealer usually advanced the money with which the loader paid the grower for his potatoes, and the dealer also paid for sacks, car linings, fuel for heating the cars, and all selling expenses. There were certain expenses, however, which the commission man generally had to pay out of his commission fee per bushel. The loader frequently had to hire some labor to help him handle the potatoes. If he used a warehouse, he had to pay for taxes, insurance, and repairs. He had also to incur some expense for fuel, light and power, office supplies, and telegraph and telephone. Commission loaders made considerable use of

automobiles in visiting growers; they also hired some potatoes hauled to the shipping point; and some rented sheds or warehouses. A questionnaire was sent to all of the commission loaders, asking for statements as to expenses incurred by them. Replies covering 237 carloads showed an average cost per carload as follows:

Hired labor	$14 33
Taxes	0 105
Insurance	0 10
Repairs.	0.31
Use of automobile	1 94
Cartage of potatoes	0.36
Fuel, light, and power.	0 30
Office supplies	0.10
Telephone and telegraph	0.38
Miscellaneous	0.16
Total expenses per car	$18.085
Total expenses per bushel	$0.0301

If the commission loader received an average of 6.52 cents a bushel, and his expenses were on the average 3.01 cents a bushel, he actually netted for his own labor 3.51 cents a bushel.

Since 31 per cent of the volume shipped by these dealers was handled on a commission basis, it would seem to indicate that this was a popular method for handling potatoes. Dealers point out, however, that because the commission loaders have no pecuniary interest in the potatoes themselves, and because the larger the volume they load, the greater are their returns, they are likely to overbuy.

Joint-account basis.— Approximately 1,153,370 bushels, or about 43 per cent of the total volume, were loaded on the joint-account basis. For those who are familiar with the process of share-renting a farm, it will suffice to say that joint-account loading is very similar. There are many variations in the details of share-renting contracts on different farms. Agreements between dealers and joint-account loaders are likewise variable. Essentially, however, the joint-account loader agreed to be responsible for half of the costs and losses, and to receive half of the profits, on the cars so loaded. Usually the dealer supplied money for buying potatoes, sacks, linings, and fuel, and paid all selling costs. The joint-account loader furnished his own labor and perhaps a warehouse. Account was kept of the expenses incurred at the shipping point, and the costs were divided between the loader and the dealer. If any profit over the gross cost of the carload was made, it was usually divided equally between the loader and the dealer. Losses were likewise shared. The pay of the joint-account loaders was contingent upon profits.

Joint-account loaders were usually employed on this basis for either or both of two reasons. From the dealer's point of view, loading on the joint-account basis was thought to make the loader more careful and efficient in buying, since he was to share in losses as well as in profits. On the other hand, joint-account loaders were usually not satisfied with the rates paid for loading on commission, and preferred to forego a certain but perhaps lower compensation in the hope of getting a higher but more uncertain return. During the 1921–22 season, the actual compensation

received by joint-account men averaged 3.16 cents and ranged from 0.54 to 5.05 cents a bushel. If these men had loaded on the commission basis, they would probably have received an average net wage of about 3.51 cents a bushel.

The joint-account basis of loading potatoes has not been entirely satisfactory from either the dealer's or the loader's viewpoint. The dealers stated that while the loader was always willing to share profits, he frequently failed to share losses. The loader felt that the cars loaded by him were not given as much consideration in the matter of sales as were cars loaded on salary or on commission. For example, a dealer may have a demand for three carloads of potatoes at the following prices per carload: \$600, \$610, \$615. He may have three cars on the track, one of them loaded on the salary basis, one on the commission basis, and one on the joint-account basis. The dealer stands all of the expense for the salary-loaded car, and likewise for the commission-loaded car; for the joint-account car, he stands only half of the loading expense. Since the dealer had heavier expenses on the salary- and commission-loaded cars, it seems logical to believe that he would use those cars to fill the higher-priced orders and sell the joint-account car for the lowest price. Joint-account loaders contend that this is likely to occur. At least one of the dealers gave the joint-account loader a choice in the matter.

It may be of interest to note that 78 per cent of the volume shipped by these dealers in 1921–22 was loaded on such a basis that the loader received pay only when he actually worked. This was a tacit recognition of the fact that potato shipping is very irregular. By using the commission and joint-account bases for loading, these dealers avoided the necessity of paying for a great deal of idle labor The same principle was used by most of the cooperatives in paying for loading on the bushel or the hundredweight basis.

Social as compared with actual costs

Society, including producer and consumer alike, is interested not only in the partial costs borne by these many-station dealers, but in the total costs of handling potatoes by these agencies. The costs shown by the books of the many-station dealers do not include expenses incurred by loaders on the commission basis, or the proportional expenses borne by the joint-account loaders. Some of the so called "profit" of the joint-account loader may properly be included in operating costs; some of it must be excluded in accordance with good economic theory.[15] The total costs to society of handling potatoes, for these nine many-station dealers, are given in tables 60 to 67.[16]

Primary and group operating costs

The items of expense incurred in the handling and shipping of potatoes by these many-station dealers during the 1921–22 season are given in table 60.

Labor and management.— The cost of labor and management per carload varied from \$21.32 to \$42.71, with an average of \$29.05 (table 61). This was slightly above the average of all the agencies studied in 1921–22.

[15] Davenport, H. J. The economics of enterprise, p. 1–544. (Reference on p. 65–69.) 1918.
[16] The method of calculation is described in the appendix, page 164.

TABLE 60. PRIMARY OPERATING COSTS PER 600-BUSHEL CARLOAD, 9 MANY-STATION DEALERS, SEASON 1921–22

Dealer no.	51	52	53	54	55	56	57	58	60	Weighted averages‡		
Number of 600-bushel cars	473	68	504	898	174	887	417	521	511	Per car	Per bushel	Per hundred-weight
Labor	$19.46105	$14.40735	$27.83656	$23.68782	$21.37367	$32.52554	$42.71159	$24.18595	$20.18273	$26 67420	$0.07409	$0.04445
Sacks, tags, and twine	20.04795	5.43029	25.64446	20.20590	22.02741	26.89243	19 35753	23.08140	21.02796	22.33343	0.06203	0.03722
Rent for warehouse	0.85832	0.14705	1.49109	1.67017	0.20689	0 58856	1.63908	2.27359	1.14481	1.27518	0.00354	0.00212
Taxes on warehouse	0.38780	0.95720	0.85105	0.33207	0.28735	1.90135	0.10774	0 59681	0.48855	0.74504	0.00206	0.00124
Insurance:												
Stock	....	....	....	....	0.15172	0.32417	0.43155	....	0.60459	0.18029	0.00050	0 00030
Warehouse	1.06382	0.71720	0.73009	0.91693	0.14022	0 82012	0 26546	1.04774	0.17273	0.72760	0 00202	0.00121
Employer's liability	....	0.26499	....	....	....	0.18229	....	....	0.08636	0.05026	0 00013	0.00008
Fuel	0.53469	1.51588	0.45220	0.24018	0.19908	0.32692	0.59980	0.66228	1.24863	0.52940	0 00147	0.00088
Light and power	0.14608	0.13073	0.34480	0.17291	0.07356	0.65386	0.01712	0.10635	0.42146	0.28694	0.00079	0.00047
Linings	2.51329	4.41176	0.63974	1.99130	0.84994	1.95578	3.19482	1.82025	2.49495	2.02955	0.00563	0.00338
Repairs	0.31577	1.76585	2.61418	0.93253	0.67241	0.81881	0.52760	0.38708	0.88911	0.93054	0.00258	0.00155
Supplies	1.14164	0.73529	....	....	....	....	0.69410	0.33570	1.03180	0.35517	0.00098	0.00059
Miscellaneous operating expenses	2.89537	0.02588	4.70251	4.91047	0.04701	2.57322	0 41695	3.62305	0.60833	2.87759	0.00799	0.00479
Depreciation:												
Warehouse	0.97251	1.47058	2.99355	3.10690	0.57471	1.36004	0.23117	2 91781	0.56005	1.81178	0.00503	0.00301
Equipment	0.50739	0.14705	0.51486	0.43151	0.71839	1.35000	0.30522	0.73724	0.72113	0.69600	0.00193	0.00115
Officers' salaries	....	....	5.39682	3.72828	....	5.41691	....	7.71689	2.59050	3.64182	0.01011	0.00606
Manager's salary	3.72938	22.05882	....	....	7.18390	....	3.33045	....	....	1.32557	0.00368	0.00220
Office salaries	2.57949	5.95588	2.50365	3.83565	5.17241	2.08342	2.37889	2.37912	3.56469	2.94912	0.00819	0.00491
Travel	0.21987	1.78441	1.54295	1.65503	....	4.82730	1.78076	3 02724	0.61804	2.11243	0 00586	0.00352
Office supplies	0.52429	0.87397	0.72333	0.49218	0.22701	1.11890	1.06000	0.70998	0.95025	0.77330	0.00214	0.00128
Telephone and telegraph	3.31668	3.00264	3.18162	4.29617	2.06465	3 93725	4.97383	3.71476	1.16317	3.52344	0.00978	0.00587
Inspection	0.03361	....	0.27579	0.00445	0.02298	0.07117	0.01918	0.00453	0.04696	0.05853	0.00016	0 00009
Office rent	....	....	....	....	0.28735	....	0.57093	....	....	0.06469	0 00017	0.000[illegible]0
Brokerage and commissions	3.62494	....	7.64974	7.70317	5.93229	9.63777	4.17393	8.00321	9.48853	7.37194	0.02047	0.01228
Advertising and publicity	....	....	....	....	....	0.36369	....	0.30912	0.35698	0.14957	0.00041	0.00024
Market service	0.18393	0.02941	0.27793	....	0.01149	0.72325	0.17841	0.30507	0.18457	0.26954	0 00074	0.00044
Interest on borrowed money	0.02995	4.41176	2.50898	0.59700	1.03448	1.51267	1.61299	1.03288	1.08761	1.21335	0 00337	0.00202
Interest on investment	1.77357	1.89044	2.07396	2.06510	1.23706	1.81971	0.68506	2 05472	1.30953	1.74005	0.00483	0.00289
Miscellaneous office expenses	....	....	....	....	....	....	....	....	....	....	....	....
Depreciation on furniture and fixtures	0.10570	0.12249	0.19533	0.06904	....	0.11250	0.00474	0.02111	0.11545	0.08770	0.00024	0.00014
Bad debts	....	....	....	....	....	....	....	....	1.38371	0.15878	0.00044	0.00026
Demurrage	....	0.66132	0.46220	....	....	0.02049	0.73213	0.10841	0.24804	0 17620	0 00048	0.00029
Bank exchange	1.49695	....	0.44484	1.59671	0.02695	1.67791	0.07388	1.62678	1.06569	1.18617	0.00329	0.00197
Freight, express, and drayage*	0.58266	0.05823	0.55271	3.26605	3.13120	0 73147	2.20213	0.63897	1.14387	1 47013	0 00408	0.00245
Total operating costs	$69.04670	$72.97647	$96.60494	$87.90752	$73.65413	$106.36098	$94 27718	$92.66866†	$77.00078	$89.77534	$0.24921	$0 14946

* See first footnote to table 22, page 56.
† Dealer no. 58 let part of a warehouse for $419.08. This amount is deducted from the total cost ($93.47304 – $0.80438 = $92.66866).
‡ Weighted averages per car, per bushel, and per hundredweight are adjusted according to those made for dealer no. 58.

TABLE 61. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 9 MANY-STATION DEALERS, 1921–22

	Western New York								Average for western New York dealers	Northern New York	Average for western and northern New York dealers
Dealer no.	51	53	54	55	56	57	58	60		52	
Number of carloads	473	504	898	174	887	417	521	511		58	
Labor and management	$21.32	$30.54	$25.55	$24.97	$35.42	$42.71	$28.05	$21.57	$29.10	$25.70	$29 05
Warehouse costs	4.90	9.53	8.52	2.90	6.73	2.85	8.08	4.05	6.55	6.78	6.55
Equipment costs	0.78	1.51	0.80	0.94	1.72	0.74	0.94	1.07	1.11	0.18	1.10
General office costs	5.58	9.22	7.03	10.32	8.97	9.31	9.04	8.25	8.25	22.99	8.47
Telephone and telegraph	3.32	3.18	4.30	2.06	3.94	4.97	3.71	1.16	3.53	3.00	3.52
Bank exchange	1.50	0.44	1.60	0.03	1.68	0.08	1.63	1.07	1.20	....	1.19
Brokerage and commissions	3.62	7.65	7.70	5.93	9.63	4.18	8.00	9.49	7.49	....	7.37
Linings	2.51	0.64	1.99	0.85	1.96	3.19	1.82	2.49	1.99	4.41	2.03
Sacks, tags, and twine	20.05	25.64	20.21	22.03	26.89	19.36	23.08	21.03	22.60	5.43	22.33
Miscellaneous	5.47	8.25	10.21	3.62	9.42	6.89	8.32	6.82	8.12	4.49	8.07
Total operating costs	$ 69.05	$ 96.60	$ 87.91	$ 73.65	$106.36	$ 94.28	$ 92.67	$ 77 00	$ 89.94	$ 72.98	$ 89.68
Amount paid to growers	591.22	573 62	566.88	562.76	564.42	556.69	569.14	566.70	568.90	573.82	568.97
Total cost of potatoes to shipper	$660.27	$670.22	$654.79	$636.41	$670.78	$650.97	$661.81	$643.70	$658.84	$646.80	$658.65
Gross sales	$758.06	$685.23	$764.66	$758.93	$787.42	$746.22	$797.90	$793.71	$764.77	$718 11	$764.07
Claims and allowances	$ 9.52	$ 8.09	$ 14.10	$ 1.88	$ 9.27	$ 9.33	$ 14.04	$ 17.62	$ 11.40	$ 4.22	$ 11.30
Freight	91.83	24.03	110.96	106.13	122.13	108.97	122.45	146.67	106.31	113.17	106.42
Net sales	$656.71	$653.11	$639.60	$650.92	$656.02	$627.92	$661.41	$629.42	$647.06	$600.72	$646.35
Net profit	....	....	....	$14.51	....	....	....	....	....	....	....
Net loss	$3.56	$17.12	$15.19	....	$14.76	$23.05	$0.40	$14.28	$11.78	$46.08	$12.30

The dealer with the lowest cost for this item handled 32 carloads per loading station, as compared with an average of 22 carloads for the nine dealers. This dealer also hired the largest part of his labor on the joint-account basis. The dealer with the highest cost for labor and management loaded an average of 17 carloads per station and hired practically all of his labor on the commission basis.

Warehouse costs.— These nine dealers operated a total of 74 warehouses, with an average value, for potato-handling purposes, of $1445.33 (table 14, page 34). The average investment in warehouses was $37.01 per carload handled, and ranged from $13.77 to $64.20. On the whole, the many-station dealers had the least expensive warehouses of the three types of shipping agencies studied; but because of the relatively smaller volume handled per warehouse, the investment per carload handled was above that of the single-station dealers though considerably below that of the cooperatives (table 14). The warehouse cost varied from $2.85 to $9.53 per carload handled, with an average of $6.55, or an annual cost of about 1 cent a bushel. The tendency seemed to be toward reduction in number of warehouses, rather than toward expansion.

Equipment cost.— The average cost per carload for use of equipment was $1.10, ranging from 18 cents to $1.72. The average investment in equipment per warehouse was $223.33, ranging from $35 to $395.63 (table 16, page 41). Although the many-station dealers had the lowest investment in equipment of the three types of agencies, their average equipment cost per carload was the highest because of the smaller number of carloads per warehouse. Several of these dealers used electrically driven graders, but hand graders were in the majority. None of the dealers had any dumping equipment.

Brokerage and commissions.— All of these dealers sold more or less of their potatoes directly to wholesale receivers without the aid of brokers. On the other hand, every one of them made use of brokers both in the potato-producing area and in the terminal markets. The average brokerage and commission fees amounted to $7.37 per carload, with a range from $3.62 to $9.63. The dealer whose brokerage and commission fees amounted to only $3.62 had been in the potato-shipping business for about thirty years and knew the trade intimately. Several of the dealers had serious objections to the practice that has grown up during the past few years among city receivers, of sending all orders through one brokerage firm, whether or not the broker was instrumental in bringing seller and buyer together. The city receiver evidently hoped to get better brokerage service by such an arrangement. The many-station dealer felt that he was being deprived of $10 a carload which legitimately belonged to him for having effected the sale directly to the receiver.

Linings.— Some of these dealers spent as much as $4.41 per carload for car linings; others spent as little as 64 cents. The average cost for car linings was $2.03 per carload.

Sacks, tags, and twine.— With the exception of a northern New York dealer, no. 52, the many-station dealers all used bright, new, 150-pound sacks. The nine dealers used 947,249 sacks in shipping their potatoes during the 1921–22 season. The average cost per carload was $22.33, ranging from $5.43 to $26.89. The dealer with the highest cost

for sacks used a very attractively trade-marked and colored sack. His net sales were the second highest of all those of the nine dealers.

Total operating costs.— The total operating costs per carload varied from $69.05 to $106.36, with an average of $89.68. The difference between the highest and the lowest cost was equal to about 6 cents a bushel. The variation between costs in this group of many-station dealers was not nearly so wide as that for the cooperatives or for the single-station dealers in the same year.

Amount paid to growers.— The growers received, on the average, $568.97 per carload, or approximately 95 cents per bushel, for the potatoes marketed through these dealers. The average price paid to the grower by the individual dealers varied from $556.69 a carload, or about 93 cents a bushel, to $591.22 a carload, or about 99 cents a bushel. This was slightly above the average for the entire twenty four agencies studied during the 1921–22 season.

Claims and allowances.— These nine dealers allowed claims ranging from $1.88 to $17.62 per carload, with an average of $11.30. It seems likely that a dealer who had loaders working for him at thirty different points would have more difficulty in getting the potatoes well graded and loaded than if he could directly supervise every carload. The difficulty of supervision probably accounts for the slightly higher-than-average claims allowed by these dealers.

Profits and losses.— A shipper with many years of experience in the potato-marketing business assured the writer that no profits could be made when there was a steady market for long periods. During the 1921–22 season, prices started at a high point in September and declined slowly but steadily throughout the season, with only a few minor recoveries. Buyers who bought one day frequently found their potatoes worth less on the following day, and many carloads were sold at cost in order to avoid greater loss. During the season only one of the nine dealers made a profit, this being $14.51 per carload. This dealer had next to the smallest volume, and paid the growers the second lowest price per bushel, of all the dealers. The remaining eight dealers had losses ranging from 40 cents to $46.08 per carload handled, with an average loss of $12.30. The experience of these many-station dealers tallied closely with that of the single-station dealers. Of the seventeen many- and single-station dealers, only three managed to make a profit, and the remainder experienced losses ranging from 40 cents to $46.08 per 600-bushel carload.

Comparisons of group operating costs and returns on different bases

Bushel and hundredweight bases.— The operating costs and returns on the bushel and hundredweight bases for these dealers are given in tables 62 and 63.

As percentages of total operating costs.— On the average, approximately 32.4 per cent of the total operating costs of the many-station dealers consisted of labor and management. Other large items were sacks, tags, and twine, 24.9 per cent; general office costs, 9.45 per cent; and brokerage and commissions, 8.22 per cent. The variations in the percentages of operating costs of individual dealers are given in table 64.

As percentages of net sales.— The many-station dealers paid an average of $13.87 for operating expenses, out of every $100 of net sales. They also

TABLE 62. GROUP OPERATING COSTS AND RETURNS PER BUSHEL, 9 MANY-STATION DEALERS, SEASON 1921–22

	Western New York								Weighted average for western New York dealers	Northern New York	Weighted average for western and northern New York dealers
Dealer no.	51	53	54	55	56	57	58	60		52	
Number of bushels	283,887	302,210	538,617	104,393	532,420	25,323	312,383	306,680		41,044	
Labor and management	$0.03552	$0.05092	$0.04259	$0.04161	$0.05900	$0.07115	$0.04676	$0.03592	$0.04850	$0.04257	$0.04841
Warehouse costs	0.00815	0.01590	0.01420	0.00483	0.01121	0.00475	0.01347	0.00674	0.01091	0.01123	0.01091
Equipment costs	0.00129	0.00251	0.00133	0.00156	0.00286	0.00122	0.00156	0.00178	0.00185	0.00028	0.00182
General office costs	0.00029	0.01537	0.01172	0.01720	0.01495	0.01550	0.01507	0.01374	0.01374	0.03809	0.01412
Telephone and telegraph	0.00552	0.00530	0.00716	0.00344	0.00655	0.00828	0.00619	0.00193	0.00588	0.00497	0.00587
Bank exchange	0.00249	0.00074	0.00266	0.00004	0.00279	0.00012	0.00271	0.00177	0.00200	.....	0.00197
Brokerage and commissions	0.00603	0.01275	0.01284	0.00988	0.01605	0.00695	0.01334	0.01580	0.01247	.....	0.01228
Linings	0.00418	0.00106	0.00331	0.00141	0.00325	0.00532	0.00303	0.00415	0.00332	0.00730	0.00338
Sacks, tags, and twine	0.03340	0.04276	0.03368	0.03671	0.04480	0.03224	0.03849	0.03503	0.03766	0.00899	0.03722
Miscellaneous	0.00917	0.01379	0.01707	0.00608	0.01573	0.01151	0.01393	0.01144	0.01357	0.00747	0.01348
Total operating costs	$0.11504	$0.16110	$0.14656	$0.12276	$0.17719	$0.15704	$0.15455	$0.12830	$0.14990	$0.12090	$0.14946
Amount paid to growers	0.98506	0.95662	0.94512	0.93798	0.94030	0.92735	0.94919	0.94425	0.94819	0.95068	0.94823
Total cost of potatoes to shipper	$1.10010	$1.11772	$1.09168	$1.06074	$1.11749	$1.08439	$1.10374	$1.07255	$1.09809	$1.07158	$1.09769
Gross sales	$1.26302	$1.14275	$1.27487	$1.26494	$1.31180	$1.24308	$1.33071	$1.32250	$1.27467	$1.18973	$1.27336
Claims and allowances	$0.01586	$0.01349	$0.02350	$0.00312	$0.01543	$0.01553	$0.02341	$0.02935	$0.01900	$0.00699	$0.01882
Freight	0.15299	0.04008	0.18500	0.17688	0.20346	0.18154	0.20421	0.24438	0.17719	0.18749	0.17734
Net sales	$1.09417	$1.08918	$1.06637	$1.08494	$1.09291	$1.04601	$1.10309	$1.04877	$1.07848	$0.99525	$1.07720
Net profit	....	....	....	$0.02420	....	....	....	....	....	....	....
Net loss	$0.00593	$0.02854	$0.02531	....	$0.02458	$0.03838	$0.00065	$0.02378	$0.01961	$0.07633	$0.02049

TABLE 63. GROUP OPERATING COSTS AND RETURNS PER HUNDREDWEIGHT, 9 MANY-STATION DEALERS, SEASON 1921–22

	Western New York								Weighted average for western New York dealers	Northern New York	Weighted average for western and northern New York dealers
Dealer no.	51	53	54	55	56	57	58	60		52	
Number of hundredweights	170,332.05	181,326.05	323,170.19	62.635.5	319,452	150,193.63	187,429.65	184,008.07		24,626.11	
Labor and management	$0.05921	$0.08487	$0.07099	$0.06935	$0.09833	$0.11858	$0.07794	$0.05987	$0.08084	$0.07096	$0.08069
Warehouse costs	0.01359	0.02650	0.02367	0.00805	0.01868	0.00792	0.02246	0.01124	0.01819	0.01871	0.01819
Equipment costs	0.00215	0.00418	0.00221	0.00260	0.00477	0.00204	0.00260	0.00297	0.00308	0.00047	0.00304
General office costs	0.01549	0.02563	0.01954	0.02869	0.02491	0.02584	0.02512	0.02290	0 02291	0.06348	0.02353
Telephone and telegraph	0.00921	0.00884	0.01193	0.00573	0.01093	0.01380	0.01032	0.00323	0.00981	0.00829	0.00978
Bank exchange	0.00415	0.00123	0.00443	0.00007	0.00465	0.00020	0.00452	0.00295	0.00334	....	0.00329
Brokerage and commissions	0.01006	0.02126	0.02140	0.01647	0.02675	0.01158	0.02224	0.02634	0.02079	....	0 02047
Linings	0.00697	0.00177	0.00553	0.00236	0.00543	0.00887	0.00505	0.00692	0.00553	0.01218	0.00563
Sacks, tags, and twine	0.05567	0.07127	0.05614	0.06119	0.07466	0.05374	0.06415	0.05839	0.06276	0.01499	0.06203
Miscellaneous	0.01523	0.02296	0.02842	0.01010	0.02620	0.01917	0.02319	0.01902	0 02259	0.01243	0 02245
Total operating costs	$0.19173	$0.26851	$0.24426	$0.20461	$0.29531	$0.26174	$0.25759	$0.21383	$0.24984	$0.20151	$0.24910
Amount paid to growers	1.64175	1.59438	1.57519	1.56332	1.56715	1.54558	1.58203	1.57375	1.58033	1 58449	1.58039
Total cost of potatoes to shipper	$1.83348	$1.86289	$1.81945	$1.76793	$1.86246	$1.80732	$1.83962	$1.78758	$1.83017	$1.78600	$1.82949
Gross sales	$2.10503	$1.90460	$2.12476	$2.10826	$2.18632	$2.07180	$2.21791	$2.20417	$2.12445	$1.98291	$2.12228
Claims and allowances	$0.02644	$0.02249	$0.03918	$0.00521	$0.02573	$0.02589	$0.03902	$0.04892	$0 03167	$0 01166	$0.03136
Freight	0.25499	0.06680	0.30833	0.29481	0.33910	0.30256	0.34036	0.40730	0.29531	0.31249	0.29558
Net sales	$1.82360	$1.81531	$1.77725	$1.80824	$1.82149	$1.74335	$1.83853	$1.74795	$1.79747	$1.65876	$1.79534
Net profit	....	....	....	$0.04031	....	....	....	....	....	....	....
Net loss	$0.00988	$0.04758	$0.04220	....	$0.04097	$0.06397	$0.00109	$0.03963	$0.03270	$0.12724	$0.03415

Dealer no.	Western New York 51	53	54	55	56	57	58	60	Average for western New York dealers (per cent)	Northern New York 52	Average for western and northern New York dealers (per cent)
Groups	Per cent									Per cent	
Labor and management	30.89	31.60	29.07	33.90	33.30	45.30	30.26	28.00	32.36	35.22	32.40
Warehouse costs	7.09	9.87	9.69	3.94	6.32	3.03	8.72	5.26	7.28	9.29	7.31
Equipment costs	1.12	1.56	0.91	1.27	1.62	0.78	1.01	1.39	1.24	0.24	1.22
General office costs	8.08	9.55	8.00	14.02	8.44	9.87	9.75	10.71	9.17	31.50	9.45
Telephone and telegraph	4.80	3.29	4.88	2.80	3.70	5.28	4.01	1.51	3.93	4.11	3.93
Bank exchange	2.17	0.46	1.82	0.04	1.58	0.08	1.76	1.39	1.34		1.32
Brokerage and commissions	5.25	7.92	8.76	8.05	9.06	4.43	8.64	12.32	8.32		8.22
Linings	3.64	0.66	2.27	1.15	1.84	3.39	1.96	3.24	2.21	6.05	2.26
Sacks, tags, and twine	29.04	26.55	22.99	29.91	25.28	20.53	24.91	27.31	25.12	7.44	24.90
Miscellaneous	7.92	8.54	11.61	4.92	8.86	7.31	8.98	8.87	9.03	6.15	8.99

TABLE 65. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, 9 MANY-STATION DEALERS, SEASON 1921–22

Dealer no.	Western New York 51	53	54	55	56	57	58	60	Average for western New York dealers (per cent)	Northern New York 52	Average for western and northern New York dealers (per cent)
Groups	Per cent									Per cent	
Labor and management	3.24	4.67	3.99	3.84	5.39	6.80	4.24	3.43	4.50	4.28	4.50
Warehouse costs	0.75	1.46	1.33	0.45	1.03	0.45	1.22	0.64	1.01	1.13	1.01
Equipment costs	0.12	0.23	0.13	0.14	0.26	0.12	0.14	0.17	0.17	0.03	0.17
General office costs	0.85	1.41	1.10	1.59	1.37	1.48	1.37	1.31	1.27	3.83	1.31
Telephone and telegraph	0.51	0.49	0.67	0.32	0.60	0.79	0.56	0.18	0.55	0.50	0.54
Bank exchange	0.23	0.07	0.25	....	0.25	0.01	0.24	0.17	0.19	.	0.18
Brokerage and commissions	0.55	1.17	1.20	0.91	1.47	0.67	1.21	1.51	1.16	. .	1.14
Linings	0.38	0.10	0.31	0.13	0.30	0.51	0.28	0.40	0.31	0.73	0.31
Sacks, tags, and twine	3.05	3.93	3.16	3.38	4.10	3.08	3.49	3.34	3.49	0.90	3.46
Miscellaneous	0.83	1.26	1.60	0.56	1.44	1.10	1.26	1.08	1.25	0.75	1.25
Total operating costs	10.51	14.79	13.74	11.32	16.21	15.01	14.01	12.23	13.90	12.15	13.87
Claims and allowances	1.45	1.24	2.20	0.29	1.41	1.49	2.12	2.80	1.76	0.70	1.75

allowed claims averaging $1.75 for every $100 of net sales. The large items of expense were: labor and management, $4.50; warehouse costs, $1.01; general office costs, $1.31; brokerage and commissions, $1.14; and sacks, tags, and twine, $3.46. The variations in these amounts for the individual dealers are given in table 65.

Score cards showing relative standing in efficiency.— The many-station dealers were scored in a manner similar to the cooperatives and single-station dealers. On the basis of costs and allowances (table 66), dealer no. 55 was the most efficient. The items in which his costs were high were general office cost, and sacks, tags, and twine. On the basis of returns (table 67), however, this dealer ranked fifth in efficiency. Dealer no. 51 ranked second in efficiency in costs, and first in efficiency in returns.

TABLE 66. SCORE CARD OF OPERATING COSTS, AND CLAIMS AND ALLOWANCES, 9 MANY-STATION DEALERS, SEASON 1921–22*

Dealer no.	51	52	53	54	55	56	57	58	60
Groups	Per cent of average								
Labor and management	74	90	107	89	87	124	149	98	75
Warehouse costs	79	109	153	137	47	108	46	130	65
Equipment costs	74	17	144	76	90	164	70	90	102
General office costs	67	275	110	84	124	107	112	108	99
Telephone and telegraph	108	98	104	140	67	128	162	121	38
Brokerage and commissions	41	0	86	86	66	108	47	90	106
Linings	124	218	32	99	42	97	158	90	123
Sacks, tags, and twine	102	28	130	102	112	136	98	117	107
Miscellaneous	74	61	111	138	49	127	93	112	92
Claims and allowances	86	38	73	128	17	84	84	127	159
Total score	829	934	1,050	1,079	701	1,183	1,019	1,083	966

* The lowest score is the most efficient Average = 1000

TABLE 67. SCORE CARD OF RETURNS, 9 MANY-STATION DEALERS, SEASON 1921–22 *

Dealer no.	51	52	53	54	55	56	57	58	60
Items	Per cent of average								
Amount paid to growers	104	101	101	100	99	100	98	101	100
Net sales	102	93	101	99	101	102	97	103	98
Total score	206	194	202	199	200	202	195	204	198

* The highest score is the most efficient. Average = 200.

His business seemed to be well balanced, although expenditures for telegraph and telephone, linings, and sacks were somewhat above the average. Dealer no. 56 ranked third in efficiency in returns, but ninth in efficiency in costs. Costs for labor and management, equipment, telephone and telegraph, sacks, tags, and twine, and miscellaneous expenses, were all above the average. This dealer was efficient in selling, but there was evidently need for close attention to operating costs.

On the whole, the score cards applied to the many-station dealers did not show the wide ranges in efficiency exhibited by the cooperatives and the single-station dealers.

Season 1922–23

The records of twelve many-station dealers were studied for the 1922–23 season. Six of these dealers had headquarters in Steuben County, three in Allegany County, two in Clinton County, and one in Cayuga County. They operated at a total of 202 stations, at which they loaded 3247 carloads of 600 bushels each, or an average of 16 carloads per station (table 68).

TABLE 68. NUMBER OF LOADING STATIONS AND VOLUME PER STATION, 12 MANY-STATION DEALERS, SEASON 1922–23

Dealer no.	Number of loading stations	Number of 600-bushel carloads shipped	Average number of 600-bushel carloads per station
151	9	301	33
152	8	78	10
154	28	356	13
155	6	111	12
156	35	492	14
157	34	416	12
158	17	266	16
159	37	575	16
160	14	372	27
162	2	85	43
163	10	59	10
164	2	136	68
Total	202	3,247	16

None of these dealers handled as great a volume as did the many-station dealer handling the largest volume during the 1921–22 season. Dealers nos. 151, 152, 154, 155, 156, 157, 158, and 160 were included also in the first season. The volume handled by them in 1921–22, with the exception of dealer no. 151, was reduced approximately 50 per cent during the 1922–23 season, due largely to a smaller crop. The average number of carloads per station decreased from 22 in 1921–22 to 16 in 1922–23.

These dealers were all engaged in some other line or lines of work (table 69) which kept them busy during idle moments in the potato business. Yet each one handled a volume of potatoes which would be considered a

TABLE 69. Agricultural Products Shipped, and Other Enterprises Engaged in, 12 Many-Station Dealers, Season 1922–23

Dealer	Agricultural products shipped	Other enterprises engaged in by dealer	Per cent of total business that potatoes constituted
A	Potatoes, hay, rye, buckwheat, wheat, oats	Lime and fertilizer	87
B	Potatoes, apples, hay	Farm machinery, farming, feed	25
C	Apples, buckwheat, hay, rye, wheat, beans, barley, potatoes	....	22
D	Potatoes	Tile manufacture	50
E	Apples, buckwheat, potatoes, hay, wheat, cabbage, grapes	....	69
F	Potatoes, hay, cabbage, buckwheat, apples, oat straw	Lime, farming, produce business in the South during summer	79
G	Hay, potatoes, grapes, apples, cabbage, buckwheat, rye	Fertilizer and lime	62
H	Potatoes, hay, apples, cabbage, buckwheat	....	92
I	Potatoes, hay, wheat, rye, apples, buckwheat, beans, wool	Feed, fertilizer, seed	18
J	Potatoes, Christmas trees, apples.	Feed, fertilizer	50
L	Potatoes, barley, beans, wheat, buckwheat, apples, hay, cabbage, straw	Lumber, bricks, fertilizer, feed, coal, lime	7
M	Potatoes, grapes	Coal, feed	50

large business if handled by a cooperative or a single-station dealer. Experience seems to have taught these dealers that it is not wise to rely on one line of business alone.

Volume of potatoes shipped

During the 1922–23 season, these twelve many-station dealers received and shipped 116,950,810 pounds of potatoes, or 1,949,179 bushels, equivalent to 3247 carloads of 600 bushels each. These potatoes actually moved to market in 3145 shipments. Approximately 15,597,813 pounds, or 13.3 per cent of the total volume, moved in bulk; the remainder, 101,353,007 pounds, or 86.7 per cent, were shipped in sacks. One of the dealers located in Clinton County shipped all of his potatoes in bulk; the other dealer in that county shipped 58 per cent in bulk. Only one of the dealers in western New York shipped as much as 24 per cent in bulk. The other dealers shipped from 0.94 to 12.68 per cent in bulk.

Potato prices ranged relatively low during the 1922–23 season, and there was little demand for second-grade stock. Of the total volume shipped by these dealers, 716,680 pounds, or approximately 20 carloads of 600 bushels each, were sold as United States no. 2 grade, or seconds. The remainder, which was 99.39 per cent of the total, were shipped as United States no. 1 grade, or firsts.

These dealers shipped their potatoes to an average of 8 States, the number of States ranging from 2 to 14. The average number of destinations reached per dealer was 43, with a range from 2 to 93. Shipments per State averaged 30 carloads and ranged from 11 to 50 carloads.

These twelve many-station dealers handled approximately 70 per cent of the volume of potatoes shipped by all the agencies studied, and about 27 per cent of all up-state potatoes shipped in carloads during the 1922–23 season.

Methods of operation

During the season 1922–23, these twelve dealers bought approximately 4 per cent of their volume outright, loaded in cars; 26 per cent was loaded on the salary basis, either at the home office of the dealer or by a few loaders hired at outside points; 33 per cent was loaded on the commission basis; and 37 per cent was loaded on the joint-account basis. These proportions were substantially the same as for the nine many-station dealers studied during the 1921–22 season. The joint-account method was the one most widely used, and averaged for the two seasons about 40 per cent of the total volume; the commission method of loading averaged about 32 per cent for the two seasons; the salary-basis method averaged approximately 24 per cent; and about 4 per cent of the potatoes were bought outright.

There was considerable variation in the practice of the individual dealers during the 1922–23 season. Two dealers loaded all of their potatoes on the salary basis; two loaded about 20 per cent on the salary basis and 80 per cent on the joint-account basis; one loaded about 30 per cent on the salary basis and 70 per cent on the commission basis; one bought about 40 per cent of his volume outright, and loaded the remainder largely on the salary basis, with one carload on the commission basis; one loaded approximately 50 per cent on the joint-account basis, 40 per cent on the commission basis, and 10 per cent on the salary basis, but did not buy any carloads outright; the remaining five dealers used all four methods of loading, in varying proportions. There was thus no uniform or standard method of handling the potatoes; each dealer followed the system which seemed to him to offer the best advantages, and this, of course, differed with the personalities and the circumstances of the men who were to do the loading.

Salary basis.— The average cost of loading on the salary basis during the 1922–23 season, as nearly as could be ascertained, was 6.08 cents a bushel, and approximately 497,687 bushels were so loaded by these dealers. The cost of loading on this basis varied from 1.17 to 9.82 cents a bushel. The average cost of loading on the salary basis, for the two seasons, was approximately 6 cents a bushel.

Commission basis.— The rate paid for loading on the commission basis during the 1922–23 season varied from 4.67 to 6.11 cents a bushel, and averaged 5.3 cents a bushel for the 650,073 bushels so handled. If expenses incurred by the commission loader averaged 3.01 cents a bushel (as indicated by the results of the questionnaire referred to on page 106), the commission loader netted, on the average, about 2.29 cents a bushel for his own labor and managerial efforts.

The average cost of loading on the commission basis, for the two seasons, was approximately 5.91 cents a bushel.

Joint-account basis.— Neither of the two methods just discussed was as sensitive to prosperity or lack of prosperity in the business as was the joint-account method. In a year when large profits were made, the cost of loading potatoes on this basis would probably be very high, and the reverse would probably be the case in a year of small profits or heavy losses. The two seasons during which this study was made were years in which losses were incurred by most of the dealers. It was therefore to be expected that the actual cost of loading on the joint-account basis would be low for those two seasons. During the 1922–23 season, this cost varied from 1.5 to 6.9 cents a bushel and averaged 2.84 cents. The average cost of loading on the joint-account basis, for the two seasons, was approximately 3 cents a bushel.

From the point of view of the dealer, the joint-account method of loading potatoes was apparently the cheapest method during the seasons 1921–22 and 1922–23. The foregoing data may indicate that in years when the prospects point to small profits or large losses, the most advantageous method of loading is on the joint-account basis. In years when there is a likelihood for profit, the commission method is probably more advantageous to the dealer. In any event, the data thus far gathered indicate that the salary method was the most expensive. This may have been due to the inherent difficulty of keeping the labor profitably employed under conditions of highly irregular receipts of potatoes.

The items of expense incurred in the handling and shipping of potatoes by these dealers during the 1922–23 season are given in table 70.

Primary and group operating costs

Labor and management.— Differences in the method employed in loading potatoes probably account for a good share of the variation of the labor and management costs incurred by these dealers (table 71). The average cost per carload for the twelve dealers was $27.99, varying from $14.61 to $40.87. The dealers who loaded entirely on the salary basis were those who had the highest costs per carload for labor and management. The dealer who purchased about 40 per cent of his volume outright, already loaded on track, naturally had the lowest cost per carload for labor and management. It may be possible to buy potatoes loaded on track, cheaper than on any of the other bases. Many of the loaders who sell their potatoes on the " bought outright, loaded on track " basis, evidently do not place a high value on their labor. Much of this loading is done during spare time from major occupations such as storekeeping, and would be largely idle time if there were no potatoes to be loaded. Any margin over actual physical costs, therefore, is better than nothing at all

It is a curious fact that costs per carload for labor and management averaged less during the 1922–23 season when, on the average, a smaller volume was handled, than during the 1921–22 season when the volume handled was approximately 50 per cent larger. The heavy losses of the 1921–22 season may have resulted in more careful attention being given to costs, or the difference may have been due to the absolutely smaller volume loaded on the salary basis during the 1922–23 season.

TABLE 70. PRIMARY OPERATING COSTS PER 600-BUSHEL CARLOAD, 12 MANY-STATION DEALERS, SEASON 1922–23

Dealer no.	151	152	154	155	156	157	158	159	160	162	163	164	Weighted averages‡		
Number of 600-bushel cars	301	78	356	111	492	416	266	575	372	85	59	136	Per car	Per bushel	Per hundred-weight
Labor	$19 38362	$4 83653	$25 29247	$18 61072	$27 46584	$26.86509	$27 75807	$26 77441	$21 39602	$22.64705	$23.57966	$26 16896	$24 51005	$0 01082	$0 06804
Sacks, tags, and twine	26.82554	7.14179	22.55143	20 04621	23.94580	20 69122	32 03383	25 38468	28 54741	0 27058	17 78847	31 30588	24 12714	0.01219	0 06698
Rent for warehouse	0 45667	......	0 87210	0 32432	0 87932	0 85413	0 84548	0 52203	0 71448	1 17647	. .	0 85294	0 70179	0 00116	0 00194
Taxes on warehouse	0.62182	0 82102	0.28061	0 45045	1 84666	1 07341	0 91845	0 46010	0 53965	0 64117	1 30898	2 57352	0 91023	0 00151	0 00252
Insurance:															
Stock	....	....	.....	....	0 20914	.....	. .	. .	0 75053	1 98823	.....	. .	0 16972	0 00028	0 00047
Warehouse	0.68704	0 43935	2 46943	0 14855	1 43241	1 06887	0 39515	0 37123	0 21446	0 88235	1 85220	1 28676	0 93739	0 00156	0 00260
Employer's liability	0 05495	0 15397	0.09831	......	0 29268	.. ..	.		0 10723				0 07620	0 00012	0.00021
Fuel	1 42362	1.28564	1 01426	0 38891	0.92865	0 70290	0 46843	0 73895	1 25174	2 29411	0 25694	0 88970	0 93275	0 00155	0.00258
Light and power	0.32548	0 11141	0 53573	0 08648	0 34863	0 24146	0 25199	0 04925	0 35959	.	0 00745	0 24999	0 25972	0 00043	0 00072
Linings	5.09036	3.07692	1 99800	1 09567	1 23888	2 10569	1 82180	0 91478	1 82088	1 23000	1 02881	2 82352	1 94882	0 00324	0 00541
Repairs	0.09189	1 49974	1 22525	1.09270	0 25847	3 23319	0 58229	0 50459	0 44817		0 11559	. .	0 86013	0 00143	0 00238
Supplies	....	0 64102	0 01500	....	....	. .....	0 12003	0 33553	1 30521	0 58823	9 56118		0 42496	0 00070	0 00117
Miscellaneous operating expenses	2 05249	0.17512	1 62609	.. ..	1 85817	0.73644	2 26143	1 11530	1 02026	0.87447	1 34779	. .	1 29595	0 00215	0 00359
Depreciation:															
Warehouse	1.52823	1 28205	2 50280	0 90090	1 50851	. .	4 13920	0 62879	0 76932	2 35294	1 26745	3 02205	1 45603	0 00242	0 00404
Equipment	0 69767	0 12820	0 30528	1.12612	1.28766	0 46062	0 45958	1 20959	0 99059	0 42352	0 51338	1 62499	0 84767	0 00141	0 00235
Officers' salaries	.... .	19 23076	3 22794	....	.. .. ..	..	10 02255	7.99999	3.51247	. .	. .	29 41176	5 43171	0 00904	0 01508
Manager's salary	5.20265	.....	...	11 26126	4 90853	2 43076	.. .	. .		35 29411	5.73559		2 20683	0 00367	0 00612
Office salaries	3 09411	3 65384	1 85634	8 10810	2 82170	2 16776	2 06627	1 91999	4 51661	. . .	0 91542	2 82352	2 72222	0 00453	0 00755
Travel	0.00724	1 30692	1 25469	0 67567	3 01841	3 19487	1 01571	1 57257	0 50809	. . . .	1 57152	1 47058	1 56946	0 00261	0 00435
Office supplies	0 32980	0 74910	0 51342	0.36036	0 62310	0 61567	0 72003	0 36730	0 40411	1 29411	0 46101	0 73529	0 53385	0 00088	0 00148
Telephone and telegraph	3 22066	2 56897	3 13567	1 94351	3 53817	5 99204	3 47387	2 81481	1 10107	2 58823	3 17728	2 58823	3 21740	0.00535	0 00893
Inspection	3 43674	.	1 81179	0 45045	0.95853	. .	0 08891	0 27008	... .	.	. . .	0 02941	0 80795	0 00134	0 00224
Office rent	....	.. .	0 55617	....	.	0.65365	.	. .	. .	.	.	. .	0 14856	0 00024	0 00041
Brokerage and commissions	3 56312	3.55307	9.55654	3 96846	4.47703	6 43326	12 72192	6,36808	7 31349	58 59352	1 35593	5 44117	7 89613	0 01315	0 02192
Advertising and publicity	.... ..	.. ...	0 19926	.. ...	0 63459	.. .. .	0 55481	0 10559	0 25545	..	.. ..	... .	0 21142	0 00035	0 00058
Market service	0.24737	0 02564	0 06087	0 01801	0 19284	0 18968	0 37819	0 24319	0 20510	0.05882	. ... .	. .	0 18344	0 00030	0 00050
Interest on borrowed money	0 06392	3 84615	.....	1 62162	2 76833	0 03293	1 25519	0 61951	3 04209	.. . .	0 85254	.	1 15508	0 00192	0 00320
Interest on investment	2 68607	1 55705	1 60179	1 81756	2 53004	1 03180	3 08394	1 61048	1 62846	3 87176	5 10694	5 04624	2 16346	0 00360	0 00600
Miscellaneous office expenses	... .	... ...	.. ..	.. ..	. .	.. .	.. . .	. .	. . .	. ....	. ..	0 18382	0.00769	0 00001	0 00002
Depreciation on furniture and fixtures	0.14451	0 10679	0 06179	... .	0 28749	0 01668	0.02563	0 04519	0 11672	0 02352	0 25661	. .	0 09719	0 00016	0 00026
Bad debts	....	.. .	.....	.....	..	....	......	. ..	0 93002	2.94117	.... .	1 10294	0 22974	0 00038	0 00063
Demurrage	.... .	3 20512	1 95140	....	0 31205	0 82371	0 23796	0 45043	1 42741	7 05882	. .	0.04411	0 89319	0 00148	0 00247
Bank exchange	0.93694	0.01743	0 89794	....	0 74690	1 83427	0 77887	0 22728	0 21443	3 52941	2 09372	.. . ..	0 79627	0 00132	0 00221
Storage	....	.. ..	. ...	... ...	. .	...	. . ...	. .	. .	. . .	....	. ...	...	.	.. ....
Freight, express, and drayage*	0 51212	0.00461	1 94876	1 65558	0 86477	0 08269	1 89157	0 75980	2 28588	3 82352	. .. .	.. . .	1 22627	0 00204	0 00340
Total operating costs	$82.68463	$61 41821	$89.42113	$76 15161	$92.18264	$84 46582	$110 52093†	$84 38352	$87.72694	$154.44611	$80 15446	$119 67538	$90 89722	$0 15125	$0 25219

* See first footnote to table 22, page 56.

† Dealer 158 let part of a warehouse for $192.20. This amount is deducted from the total cost ($111.24348 – $0 72255 = $110 52093).

‡ Weighted averages per car, per bushel, and per hundredweight are adjusted according to those made for dealer no. 158.

TABLE 71. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 12 MANY-STATION DEALERS, SEASON 1922–23

	Western New York										Average for western New York dealers	Northern New York		Average for western and northern New York dealers
Dealer no.	151	154	155	156	157	158	159	160	163	164		152	162	
Number of carloads	301	356	111	492	416	266	575	372	59	136		78	85	
Labor and management	$22.04	$27.00	$24.24	$30.21	$26.87	$32.77	$30.78	$21.50	$23.58	$40.87	$27.99	$14.61	$40.29	$27.99
Warehouse costs	5.33	8.78	4.46	7.82	6.95	8.53	2.97	3.51	7.41	11.40	6.24	5.46	8.51	6.28
Equipment costs	1.13	0.36	1.40	1.52	0.67	0.69	1.93	1.64	0.78	2.12	1.26	0.14	0.80	1.22
General office costs	6.97	5.12	15.74	10.38	6.36	10.77	7.81	12.67	10.19	19.67	9.33	18.66	19.29	9.81
Telephone and telegraph	3.22	3.14	1.94	3.54	5.99	3.47	2.81	1.10	3.18	2.59	3.25	2.58	2.59	3.22
Bank exchange	0.94	0.90	.	0.74	1.84	0.78	0.23	0.24	2.09	. .	0.74	0.02	3.53	0.80
Brokerage and commissions	3.56	9.55	3.97	4.48	6.43	12.73	6.37	7.31	1.36	5.44	6.61	3.55	58.59	7.90
Linings	5.09	2.00	1.10	1.24	2.11	1.82	0.91	1.82	1.03	2.82	1.94	3.08	1.23	1.95
Sacks, tags, and twine	26.83	22.55	20.05	23.95	20.69	32.03	25.38	28.55	17.79	31.31	25.21	7.14	0.27	24.13
Miscellaneous	7.57	10.02	3.25	8.30	6.56	6.93	5.19	9.39	12.74	3.46	7.32	6.19	19.33	7.60
Total operating cost	$ 82.68	$ 89.42	$ 76.15	$ 92.18	$ 84.47	$110.52	$ 84.38	$ 87.73	$ 80.15	$119.68	$ 89.89	$ 61.42	$ 154.44	$ 90.90
Amount paid to growers	320.55	317.72	305.98	338.86	304.73	296.37	300.90	348.36	333.23	313.74	318.03	386.95	384.92	321.44
Total cost of potatoes to shipper	$403.23	$407.14	$382.13	$431.04	$389.20	$406.89	$385.28	$436.09	$413.38	$433.42	$407.92	$448.37	$539.36	$412.34
Gross sales	$471.35	$514.24	$491.71	$547.47	$505.62	$505.23	$468.60	$552.36	$543.76	$515.66	$509.32	$510.94	$629.24	$512.50
Claims and allowances	$ 9.84	$ 14.03	$ 3.16	$ 3.10	$ 6.61	$ 9.13	$ 3.56	$ 11.37	$10.14	$ 2.84	$ 7.22	$ 3.30	......	$ 6.94
Freight	86.04	102.38	99.22	106.14	98.93	106.38	68.88	106.10	97.16	100.75	95.18	108.81	$119.15	96.14
Net sales	$375.47	$397.83	$389.33	$438.23	$400.08	$389.72	$396.16	$434.89	$436.46	$412.07	$406.92	$398.83	$510.09	$409.42
Net profit	......	.....	$7.20	$7.19	$10.88	......	$10.88	....	$23.08	....	.....	....	.	....
Net loss	$27.76	$9.31	.....	.....	......	$17.17	......	$1.20	......	$21.35	$1.00	$49.54	$29.27	$2.92

Warehouse costs.— These twelve dealers operated a total of 66 warehouses, with an average value, for potato-handling purposes, of $1446.62 (table 15, page 36). The average investment in warehouses was $47.62 per carload handled, ranging from $25.64 to $84 69 None of these dealers stored any potatoes permanently for the winter. Their warehouses had, at the outset, possible winter-storage space to accommodate about 483 bushels of potatoes, or 1 carload. The actual warehouse cost per carload varied from $2.97 to $11.40 and averaged $6.28. These variations were due largely to the volume handled per warehouse. The average investment of $1446.62 indicates that these warehouses were not elaborate.

Equipment costs.— As a rule, the dealers had conservative investments in potato-handling equipment. The average investment per warehouse was $295.62 (table 17), and per loading station approximately $145. The average cost per carload for the use of equipment was $1.22, the cost ranging from 14 cents to 2.12.

Brokerage and commissions.— One of these dealers sold all of his potatoes by the joint-account method. His selling cost averaged $58 59 per carload. The costs for the remaining eleven dealers ranged from $1.36 to $12.73 per carload, and averaged approximately $6.53. The dealer whose costs ran as high as $12.73 per carload sold a number of carloads on the consigned, or commission, basis. With the exception of the dealer who sold on the joint-account basis, all of these dealers sold some of their potatoes direct to wholesale receivers without the aid of brokers. Eleven of them likewise made extensive use of the brokerage system.

Linings.— Some of these dealers set a high standard in the matter of lining cars; others evidently took chances and followed this practice less extensively. The average cost per carload for linings was $1.95, the cost ranging from 91 cents to $5.09.

Sacks, tags, and twine.— The two dealers located in northern New York did not use sacks to any appreciable extent, but the western New York dealers expended an average of $25.21 per carload for this item. Several of these dealers used attractively trade-marked sacks, which were somewhat more expensive than plain sacks.

Total operating costs.— The total operating costs per carload varied with the individual dealers from $61.42 to $119.68, and averaged $90.90 for the group. The difference between the highest and the lowest cost per carload was equal to 15.5 cents a bushel. The average cost for the nine many-station dealers during the 1921–22 season was $89.68, or $1.22 less per carload on a much larger volume handled than in 1922-23. It is unusual that with a considerable decrease in actual volume handled, the average operating cost increased as little as $1.22 per carload. On the average, these many-station dealers had the lowest operating cost per carload during the 1922–23 season, of the three types of shipping agencies studied.

Amount paid to growers.— The average amount paid to growers by these many-station dealers was $321.44 per carload, or approximately 53 cents per bushel. This was slightly less than the average amount paid by all the thirty-four agencies studied in 1922–23 The average price paid to growers by the individual dealers varied from $296.37 per carload, or 49 cents a bushel, to $386.95 per carload, or 64 cents a bushel.

Claims and allowances.— The claims allowed by these many-station dealers during the 1922–23 season averaged $6.94 per carload, as compared with $11.30 per carload allowed by the nine dealers in the preceding season. It is difficult to say just what was the cause of this decrease in claims. It was probably the result of several factors. Shipping-point inspection on the part of the state and federal governments undoubtedly contributed somewhat to this result, A better quality of potatoes, with less disease and rot, was probably another contributing element. An all-around tightening up after the disastrous 1921–22 season may have had some effect. Not all of the dealers reduced their average claims. The range in claims and allowances per carload was from $2.84 to $14.03.

Net sales.— The net sales realized from a carload of potatoes depends on at least three factors: the sales ability of the dealer, the amount of freight charges, and the claims for allowances. The freight charges ranged from $68.88 to $119.15 per carload, a variation equal to approximately 8.4 cents per bushel. The net sales realized varied from $375.47 to $510.09 per carload, a variation equal to 22.4 cents per bushel. The variation in claims per carload was equal to approximately 1.8 cents per bushel. Even allowing for an unknown differential for selling at different periods of the year, in addition to the variations due to freight and claims, it is probable that there was considerable variation among these dealers in ability as salesmen.

Profits and losses.— The position of the many-station dealer was, on the whole, better during the 1922–23 season than in 1921–22. Five of the twelve dealers managed to make a profit; during the previous season only one dealer out of nine was so fortunate. Seven of the twelve dealers experienced losses in 1922–23 ranging from $1.20 to $49.54, and the average for all twelve dealers was a loss of $2.92 per carload. The two dealers who paid the grower the most for his potatoes were the ones with the greatest losses per carload. On the basis of costs and sales, they overpaid the grower from 5 to 8 cents a bushel. The profits made by five of these dealers ranged from $7.19 to $23.08 per carload, or from 1.2 to 3.8 cents a bushel.

Comparisons of group operating costs and returns on different bases

Bushel and hundredweight bases.— The costs and returns calculated in terms of bushels or hundredweights are given in tables 72 and 73.

As percentages of total operating costs.— Approximately 31 per cent of the total operating costs of these dealers consisted of labor and management. Sacks, tags, and twine constituted almost as great a proportion, 26.54 per cent. Other items which made up large proportions of the total operating costs were: general office costs, 10.79 per cent; brokerage and commissions, 8.69 per cent; and warehouse costs, 6.9 per cent. There were wide variations in these percentages of cost among the individual dealers (table 74.)

As percentages of net sales.— During the 1922–23 season, the twelve many-station dealers expended an average of $22.19 for operating costs out of every $100 of net sales. One dealer spent approximately $1 for operating costs for every $3 of net sales. On the average, every $100 worth of potatoes sold carried with it the following expenses: labor and

TABLE 72. GROUP OPERATING COSTS AND RETURNS PER BUSHEL, 12 MANY-STATION DEALERS, SEASON 1922–23

	Western New York										Weighted average for western New York dealers	Northern New York		Weighted average for western and northern New York dealers
Dealer no.	151	154	155	156	157	158	159	160	163	164		152	162	
Number of bushels	180,562	213,498	66,723	295,465	249,801	159,803	344,753	223,307	35,325	81,687		46,974	51,281	
Labor and management	$0.03674	$0.04502	$0.04032	$0 05030	$0 04173	$0.05454	$0 05132	$0 03581	$0 03938	$0.06805	$0 04663	$0 02424	$0 06678	$0 04663
Warehouse costs	0.00889	0 01463	0.00741	0 01301	0.01157	0 01419	0 00495	0 00583	0.01238	0 01898	0 01038	0.00907	0.01410	0.01045
Equipment costs	0.00188	0 00060	0 00233	0.00254	0 00111	0 00115	0.00322	0 00277	0 00131	0 00352	0 00210	0 00023	0 00132	0 00203
General office costs	0 01162	0 00853	0 02618	0 01727	0.01059	0 01792	0 01302	0.02100	0 01701	0 03273	0 01553	0 03098	0.03197	0 01634
Telephone and telegraph	0 00537	0 00522	0.00323	0 00589	0 00907	0.00578	0.00469	0 00183	0 00530	0.00430	0 00541	0.00426	0 00429	0 00535
Bank exchange	0 00156	0.00149	...	0.00124	0 00305	0 00129	0 00037	0 00010	0 00349	.	0 00123	0 00002	0 00585	0 00132
Brokerage and commissions	0.00594	0 01593	0 00660	0 00745	0 01071	0.02118	0 01062	0 01217	0 00226	0 00905	0 01101	0.00589	0 09712	0 01315
Linings	0.00848	0.00333	0.00182	0.00206	0 00350	0 00303	0 00152	0.00303	0 00171	0.00470	0 00323	0 00510	0 00203	0 00324
Sacks, tags, and twine	0.04473	0.03760	0.03334	0.03987	0 03115	0 05332	0 04233	0 0475	0 02971	0 05212	0 04201	0.01185	0 00044	0 04019
Miscellaneous	0 01267	0.01675	0.00545	0.01386	0.01098	0 01156	0.00869	0 01568	0 02132	0 00580	0 01224	0.01034	0 03209	0 01271
Total operating costs	$0.13788	$0 14910	$0.12668	$0 15349	$0.14060	$0 18396	$0 14073	$0.14610	$0 13387	$0.19925	$0 14977	$0 10198	$0 25599	$0 15141
Amount paid to growers	0 53453	0 52977	0.50902	0 56424	0 50717	0 49332	0 50184	0.58017	0 55655	0 52234	0 52990	0 64253	0 63801	0 53546
Total cost of potatoes to shipper	$0.67241	$0 67887	$0.63570	$0.71773	$0 64813	$0.67728	$0 64257	$0.72627	$0 69042	$0 72159	$0 67967	$0 74451	$0.89400	$0 68687
Gross sales	$0.78600	$0 85746	$0.81800	$0 91160	$0 84200	$0 84097	$0.78155	$0.91901	$0 90818	$0 85852	$0 84862	$0 84841	$1.04297	$0 85373
Claims and allowances	$0.01640	$0.02339	$0.00526	$0.00515	$0.01101	$0 01519	$0 00593	$0.01802	$0 01692	$0 00472	$0.01203	$0 00549	.	$0.01155
Freight	0.14347	0.17071	0 16506	0 17673	0.16174	0 17707	0.11488	0 17670	0 16229	0 16774	0.15859	0 18067	$0.19749	0 16014
Net sales	$0.62613	$0.66336	$0.64768	$0.72972	$0.66[illegible]5	$0.64871	$0 66074	$0 72429	$0.72897	$0 68606	$0.67800	$0.66225	$0 84548	$0 68204
Net profit	....	....	$0.01198	$0.01199	$0.0181[illegible]	...	$0 01817	...	$0 03855	..		.	.	...
Net loss	$0.04628	$0.01551	....	...		$0 02857	..	$0.00198	...	$0 03553	$0.00167	$0.08226	$0 04852	$0 00483

TABLE 73. GROUP OPERATING COSTS AND RETURNS PER HUNDREDWEIGHT, 12 MANY-STATION DEALERS, SEASON 1922–23

	Western New York										Weighted average for western New York dealers	Northern New York		Weighted average for western and northern New York dealers
Dealer no.	151	154	155	156	157	158	159	160	163	164		152	162	
Number of hundredweights. . .	108,301 45	128,098 73	40,034.00	177,279.19	149,880.49	95,881.85	206,852.03	134,019 92	21,195.25	49,012 00		28,184 48	30,768 71	
Labor and management	$0 06126	$0 07505	$0 06721	$0.08385	$00.7457	$0.09090	$0.08555	$0.05969	$0 06564	$0 11342	$0 07774	$0 04042	$0.11131	$0.07772
Warehouse costs .	0 01482	0.02439	0.01235	0.02169	0.01929	0.02365	0.00825	0 00972	0 02064	0 03164	0 01731	0 01512	0 02351	0.01742
Equipment costs . . .	0 00314	0.00101	0.00389	0.00424	0.00185	0.00191	0.00538	0.00454	0 00219	0.00587	0 00350	0 00039	0 00222	0 00339
General office costs. .	0.01937	0 01423	0 04363	0.02879	0 01766	0.02987	0.02171	0 03516	0 02835	0 05457	0.02589	0 05164	0 05330	0 02723
Telephone and telegraph.	0 00895	0 00871	0.00538	0.00982	0.01663	0.00963	0.00782	0 00306	0.00884	0 00718	0 00902	0 00711	0 00715	0.00893
Bank exchange. .	0 00260	0 00249	. . . .	0.00207	0.00509	0.00216	0.00063	0 00068	0 00583	.	0 00205	0.00005	0 00975	0 00221
Brokerage and commissions.	0 00990	0 02656	0 01100	0 01242	0.01786	0.03530	0.01770	0 02030	0.00377	0 01510	0 01835	0.00983	0 16187	0.02192
Linings.	0 01415	0.00555	0.00303	0 00344	0 00584	0.00505	0.00254	0 00505	0 00286	0 00783	0 00538	0 00852	0.00340	0 00541
Sacks, tags, and twine	0.07456	0 06267	0 05558	0 06646	0 05743	0.08886	0.07056	0.07924	0 04952	0 08687	0 07001	0.01976	0.00075	0 06698
Miscellaneous.	0 02105	0.02784	0.00907	0 02305	0 01822	0.01922	0.01443	0.02606	0 03548	0 00960	0 02037	0 01713	0 05341	0.02115
Total operating costs.	$0 22980	$0.24850	$0 21114	$0.25583	$0.23444	$0.30661	$0 23457	$0 24350	$0 22312	$0 33208	$0 24962	$0.16997	$0 42667	$0 25236
Amount paid to growers	0.89090	0 88298	0.84836	0.94043	0.84579	0 82221	0 83642	0 96695	0 92758	0 87059	0 88317	1 07088	1 06335	0 89244
Total cost of potatoes to shipper	$1 12070	$1 13148	$1.05950	$1.19626	$1 08023	$1.12882	$1 07099	$1 21045	$1 15070	$1 20267	$1 13279	$1 24085	$1.49002	$1 14480
Gross sales.	$1 30999	$1 42913	$1 36333	$1.51939	$1 40336	$1.40162	$1 30260	$1 53320	$1.51363	$1 43088	$1.41437	$1 41402	$1 73830	$1 42289
Claims and allowances	$0.02734	$0 03899	$0 00876	$0 00860	$0.01835	$0 02533	$0 00990	$0.03155	$0 02821	$0.00788	$0 02005	$0 00916	. .	$0 01926
Freight.	0 23912	0.28452	0.27510	0.29457	0.27457	0 29512	0 19148	0.29452	0.27048	0.27957	0.26432	0 30113	$0 32915	0 26691
Net sales.	$1 04354	$1 10561	$1 07947	$1.21622	$1.11044	$1 08117	$1.10122	$1.2071	$1 21494	$1 14343	$1 13000	$1 10373	$1 40915	$1 13672
Net profit.	. . .	. . . .	$0.01997	$0 01996	$0.03021	. . . . . .	$0.03023	. . . .	$0 06424	. .	. .	. . .	.	
Net loss.	$0 07716	$0 02587	. . .	. . . . . .	. . .	$0 04765	. . . . .	$0.00332	.	$0 05924	$0 00279	$0.13712	$0 08087	$0.00808

TABLE 74. GROUP OPERATING COSTS AS PERCENTAGES OF TOTAL OPERATING COSTS, 12 MANY-STATION DEALERS, 1922–23

	Western New York										Average for western New York dealers (per cent)	Northern New York		Average for western and northern New York dealers (per cent)
Dealer no.	151	154	155	156	157	158	159	160	163	164		152	162	
Groups	Per cent											Per cent		
Labor and management	26.66	20.19	31.83	32.77	31.81	29.65	36.47	24.51	29.42	34.15	31.15	23.78	26.08	30.80
Warehouse costs	6.44	9.81	5.86	8.48	8.23	7.71	3.52	3.99	9.25	9.53	6.94	8.90	5.51	6.90
Equipment costs	1.37	0.43	1.84	1.66	0.79	0.63	2.29	1.86	0.98	1.77	1.40	0.23	0.52	1.35
General office costs	8.43	5.73	20.67	11.25	7.53	9.75	9.25	14.44	12.71	16.43	10.37	30.38	12.49	10.79
Telephone and telegraph	3.90	3.50	2.55	3.84	7.09	3.14	3.34	1.26	3.97	2.16	3.62	4.18	1.68	3.54
Bank exchange	1.13	1.00	......	0.81	2.17	0.71	0.27	0.28	2.61	...	0.82	0.03	2.28	0.88
Brokerage and commissions	4.31	10.69	5.21	4.86	7.62	11.51	7.55	8.34	1.69	4.55	7.35	5.79	37.94	8.69
Linings	6.16	2.23	1.44	1.34	2.49	1.65	1.08	2.08	1.28	2.36	2.61	5.01	0.80	2.14
Sacks, tags, and twine	32.45	25.22	26.32	25.98	24.50	28.98	30.08	32.54	22.19	26.16	28.05	11.63	0.18	26.54
Miscellaneous	9.15	11.20	4.28	9.01	7.77	6.27	6.15	10.70	15.90	2.89	8.14	10.07	12.52	8.37

TABLE 75. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, 12 MANY-STATION DEALERS, 1922–23

	Western New York										Average for western New York dealers (per cent)	Northern New York		Average for western and northern New York dealers (per cent)
Dealer no.	151	154	155	156	157	158	159	160	163	164		152	162	
Groups	Per cent											Per cent		
Labor and management	5.87	6.79	6.23	6.89	6.71	8.35	7.77	4.94	5.40	9.92	6.87	3.66	7.90	6.83
Warehouse costs	1.42	2.20	1.14	1.78	1.74	2.18	0.75	0.81	1.70	2.77	1.53	1.37	1.67	1.53
Equipment costs	0.30	0.09	0.36	0.35	0.16	0.18	0.49	0.38	0.18	0.51	0.31	0.04	0.16	0.30
General office costs	1.85	1.29	4.04	2.37	1.59	2.75	1.97	2.91	2.33	4.77	2.29	4.68	3.78	2.40
Telephone and telegraph	0.86	0.79	0.50	0.81	1.50	0.89	0.71	0.25	0.73	0.63	0.80	0.64	0.51	0.79
Bank exchange	0.25	0.23	....	0.17	0.46	0.20	0.06	0.06	0.48	...	0.18	0.01	0.69	0.19
Brokerage and commissions	0.95	2.40	1.02	1.02	1.61	3.25	1.61	1.68	0.31	1.32	1.62	0.89	11.49	1.93
Linings	1.36	0.50	0.28	0.28	0.53	0.46	0.23	0.42	0.23	0.68	0.48	0.77	0.24	0.48
Sacks, tags, and twine	7.14	5.67	5.15	5.46	5.17	8.17	6.41	6.56	4.08	7.60	6.20	1.79	0.05	5.89
Miscellaneous	2.02	2.52	0.84	1.90	1.64	1.77	1.30	2.16	2.92	0.84	1.80	1.55	3.79	1.85
Total operating costs	22.02	22.48	19.56	21.03	21.11	28.20	21.30	20.17	18.36	29.04	22.08	15.40	30.28	22.19
Claims and allowances	2.62	3.53	0.81	0.71	1.65	2.33	0.90	2.61	2.32	0.69	1.77	0.83	..	1.69

management, \$6.83; warehouse costs, \$1.53; equipment costs, 30 cents; general office costs, \$2.40; telephone and telegraph, 79 cents; bank exchange, 19 cents; brokerage and selling commissions, \$1.93; linings, 48 cents; sacks, tags, and twine, \$5.89; and miscellaneous expenses, \$1.85. The average dealer was called upon also to allow claims at the rate of \$1.69 per \$100 of net sales. The variations in the proportions of the net sales expended for costs by the individual dealers are shown in table 75.

Score cards showing relative standing in efficiency.— The many-station dealers studied in 1922–23 were scored on the same basis as in 1921–22 (table 76). On the basis of costs and allowances, dealer no. 155 was the most efficient. His general office costs and equipment costs, however, were above the average. This dealer ranked ninth in efficiency on returns (table 77). Dealer no. 159 ranked third in efficiency on costs and allowances. The items on which his costs were above the average were labor and management, equipment costs, and sacks, tags, and twine. He ranked only eleventh in returns. This may indicate that more attention on this dealer's part to the selling end of the business is advisable.

Dealer no. 156, whose business was studied also in the previous season, improved his position during the season of 1922–23. In the first season, this dealer ranked ninth in efficiency in costs and allowances; in the second season, he ranked fifth. Several items of cost were still above the average, notably warehouse, equipment, and telegraph and telephone costs.

TABLE 76. SCORE CARD OF OPERATING COSTS, AND CLAIMS AND ALLOWANCES, 12 MANY-STATION DEALERS, SEASON 1922–23*

Dealer no.	151	152	154	155	156	157	158	159	160	162	163	164
Groups	Per cent of average											
Labor and management	79	52	96	87	108	96	117	110	77	144	84	146
Warehouse costs	83	85	147	69	122	108	133	46	55	133	115	178
Equipment costs	89	11	28	110	120	53	54	152	129	63	61	167
General office costs	68	182	50	153	101	62	105	76	123	188	99	192
Telephone and telegraph	118	94	115	71	130	220	128	103	40	95	117	95
Brokerage and commissions	31	31	84	35	39	56	112	56	64	514	12	48
Linings	247	150	97	53	60	102	88	44	88	60	50	137
Sacks, tags, and twine	117	31	99	88	105	91	140	111	125	1	78	137
Miscellaneous	96	79	128	41	106	84	88	66	120	246	162	44
Claims and allowances	135	45	192	43	43	91	125	49	156	0	139	49
Total score	1,063	760	1,026	750	934	963	1,090	813	977	1,444	917	1,183

* The lowest score is the most efficient. Average = 1000.

TABLE 77. SCORE CARD OF RETURNS, 12 MANY-STATION DEALERS, SEASON 1922–23*

Dealer no.	151	152	154	155	156	157	158	159	160	162	163	164
Groups	Per cent of average											
Amount paid to growers	99	120	98	95	105	94	92	93	108	119	103	97
Net sales	90	96	96	94	105	96	94	95	105	123	105	99
Total score	189	216	194	189	210	190	186	188	213	242	208	196

* The highest score is the most efficient. Average = 200

WEEKLY VOLUME OF SHIPMENTS, AND PRICE

SEASON 1921–22

The potato-shipping season of 1921–22, in up-state New York, began during the week of August 29, 1921, and ended during the week of June 18, 1922. Slightly more than 52 per cent of the total volume had been shipped by November 26, 1921, in a period covering approximately three months. About 21 per cent moved to market from November 27, 1921, to January 28, 1922, and about 16 per cent from January 29 to March 25; the remaining 11 per cent were shipped between March 26 and June 24. This movement of the crop to market indicates roughly the time of the year when the growers decided to sell their potatoes. In New York State very few potatoes were stored in warehouses at the trackside. If any volume was shipped at a particular time, it was because the growers decided, for one reason or another, to haul and sell potatoes at that time. The actual dates when these potatoes moved to market, and the relation between weather, prices, and shipments throughout the season, are shown in figure 39. The net wholesale price (f.o.b. shipping point) started in the fall of 1921 at the relatively high level of \$1.67 per bushel. This was due largely to a short mid-season crop. The price declined steadily through the season, and reached 83 cents per bushel during the week of June 17, 1922.

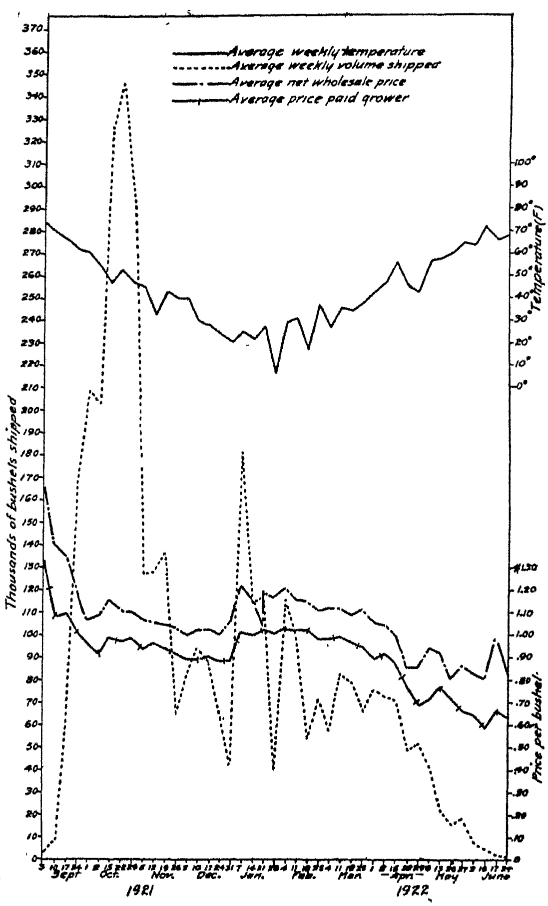

FIGURE 39. WEEKLY VOLUME SHIPPED, TEMPERATURE, NET WHOLESALE PRICE, AND PRICE PAID TO GROWERS. TWENTY-FOUR SHIPPING AGENCIES, SEASON 1921–2_

Approximately 52 per cent of the potatoes were sold at prices varying from \$1.63 to \$1 per bushel (net wholesale price f.o.b. shipping station), and averaging about \$1.11 per bushel; about 21 per cent of the total volume were sold at net prices ranging

from $1 to $1.17 per bushel, and averaging approximately $1.09; about 16 per cent were sold at prices ranging from $1.21 to $1.09 per bushel, and averaging about $1.13; and the remaining 11 per cent were sold at prices ranging from $1.06 to 83 cents per bushel, and averaging about 90 cents. There was a similar variation throughout the season in the price paid the grower. On the whole, the grower hauled and sold his potatoes during the 1921–22 season at the most favorable time from the point of view of price. A sharp fall in temperature in December, January, February, and March was usually followed by an increase in price and in volume of shipment during the next week.

While the total volume handled by the cooperatives, the single-station dealers, and the many-station dealers varied considerably, the shipments of these three groups followed about the same course throughout the year (figures 40, 41, and 42).

There has been much discussion of the orderly marketing of farm products. Potatoes have usually been included in such discussions. If the term "orderly marketing" means shipping at the time of the year when the grower will receive the most for his

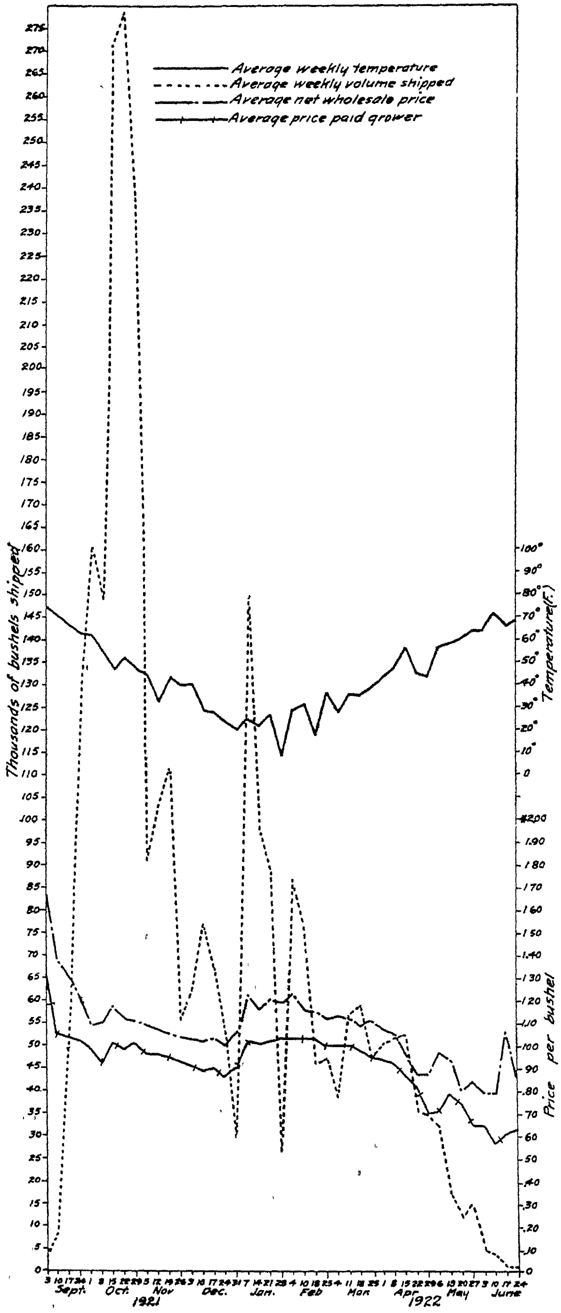

FIGURE 40. WEEKLY VOLUME SHIPPED, TEMPERATURE, NET WHOLESALE PRICE, AND PRICE PAID TO GROWER. MANY-STATION DEALERS, SEASON 1921–22

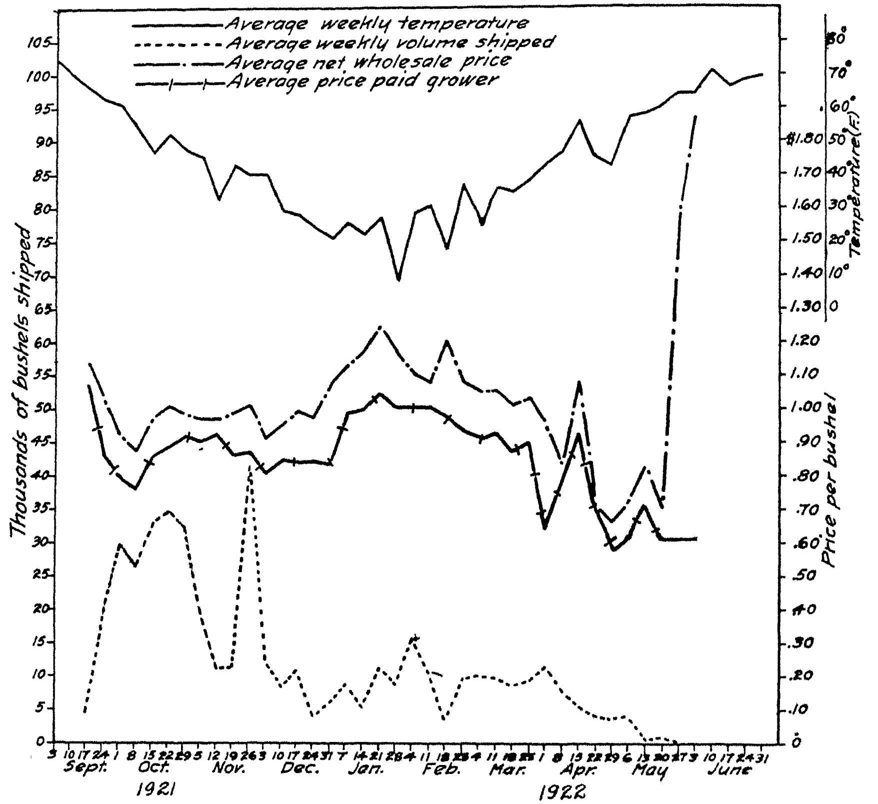

FIGURE 41. WEEKLY VOLUME SHIPPED, TEMPERATURE, NET WHOLESALE PRICE, AND PRICE PAID TO GROWER. SINGLE-STATION DEALERS, SEASON 1921–22

product, then New York growers appear to have marketed their potatoes in an orderly manner during the 1921–22 season. "Orderly marketing," however, as popularly used, means the movement to market of a certain proportion of the marketable crop each month or week. The percentage of the total volume shipped weekly by these three shipping agencies during the 1921–22 season is shown in figure 43. The black dotted line indicates the volume that would have gone to market if equal volumes had been shipped each week during the forty-three weeks of the shipping season. The cooperatives apparently came slightly closer to "feeding the market" than did either of the other two types of agencies, since from the chart it appears that their shipments varied the least from the dotted line. There was little difference, however, after the heavy shipping season was over in September and October. None of the agencies approached the alleged ideal very closely, and it seems to have been good business not to do so during the 1921–22 season. Reference to figures 39 to 42 will show that this kind of "orderly marketing" would have meant the sale of approximately 30 per cent of these potatoes at considerably lower prices than were obtained by following the market.

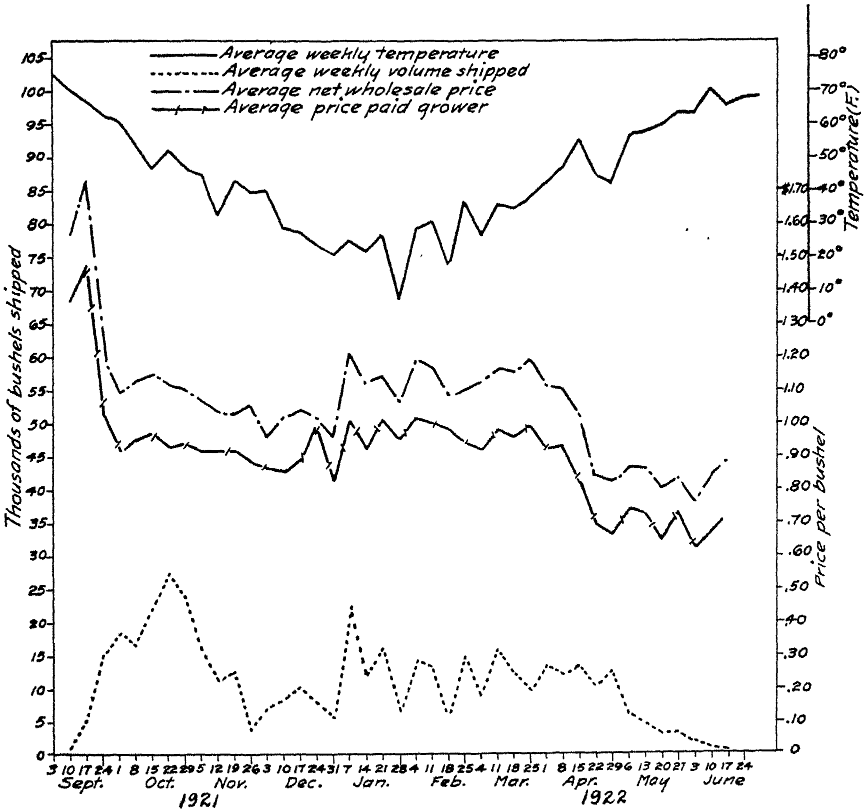

FIGURE 42. WEEKLY VOLUME SHIPPED, TEMPERATURE, NET WHOLESALE PRICE, AND PRICE PAID TO GROWER. COOPERATIVES, SEASON 1921–22

The erratic movement of these potatoes to market, as illustrated in figures 39 to 42, at once explains the widespread use of the commission and joint-account methods of loading among the many-station dealers, and the hiring of managers on the unit-handled basis among the cooperatives. Few business organizations could afford to hire on salary a force adequate to handle 2125 bushels in one week, none in the next two weeks, 6580 bushels in the fourth week, and none in the following week. Cooperative managers and private dealers faced just such problems in 1921–22. This would explain the efforts to hire on a per-unit basis and thus avoid payment for the large amount of idle time.

Comparisons of the prices paid to growers by the three types of shipping agencies during the 1921–22 season are given in figure 44. The prices paid to the growers by the many-station dealers and the cooperatives, respectively, kept within a few cents of each other throughout the shipping season. Early in the season, at least one of the cooperatives shipped green stock to market and was fortunate in obtaining high prices for it with very small losses. Of the three types of agencies, the cooperatives

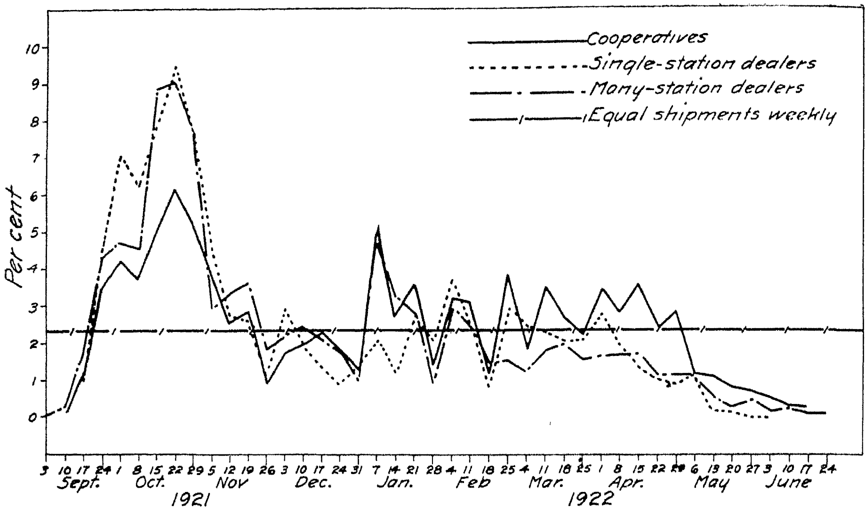

FIGURE 43. PERCENTAGE OF TOTAL VOLUME SHIPPED WEEKLY, COMPARED WITH EQUAL WEEKLY SHIPMENTS, 24 SHIPPING AGENCIES, SEASON 1921–22

started the season paying the highest price per bushel to the growers. From October 15 to December 17, the many-station dealers paid from 2 to 6 cents more per bushel than did the cooperatives. During the week ending December 24, the cooperatives paid approximately 10 cents more per bushel than did the many-station dealers. From December 31 to

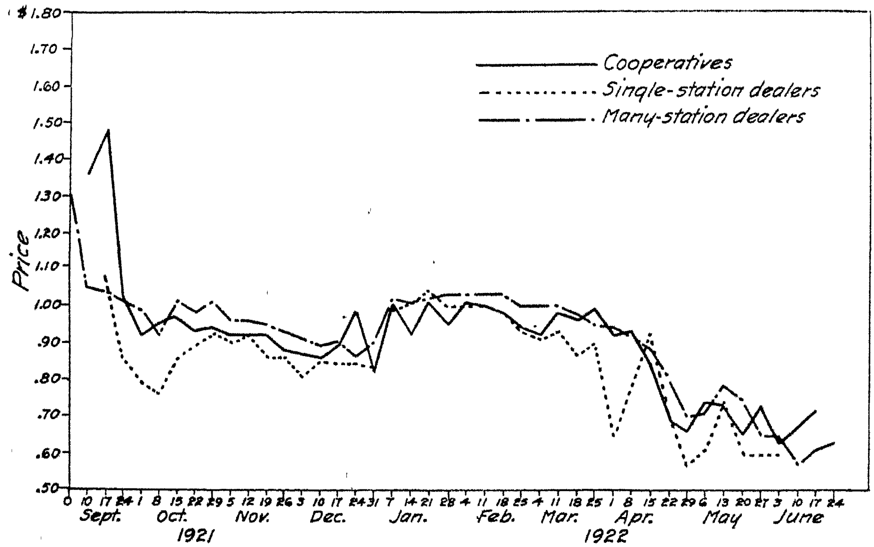

FIGURE 44. AVERAGE WEEKLY PRICE PER BUSHEL PAID TO GROWER, 24 SHIPPING AGENCIES, SEASON 1921–22

March 18, the many-station dealers again paid from 1 to 8 cents more per bushel than did the cooperatives. The respective prices paid by these two agencies were alternately high and low for the remainder of the season. These data should not necessarily be construed as showing an attempt on the part of the many-station dealers to drive the cooperatives out of business. The dealers were in sharp competition among themselves, and loaded at a large number of stations where there were no cooperative associations. In view of the heavy losses incurred by them, it seems likely that these many station dealers actually overpaid the growers during the 1921–22 season. With the exception of one or two weeks, the single-station dealers paid throughout the season a lower price to growers than did the other two types of agencies.

Comparisons of the net wholesale prices per bushel (f.o.b. shipping point) received by these three types of agencies are given in figure 45.

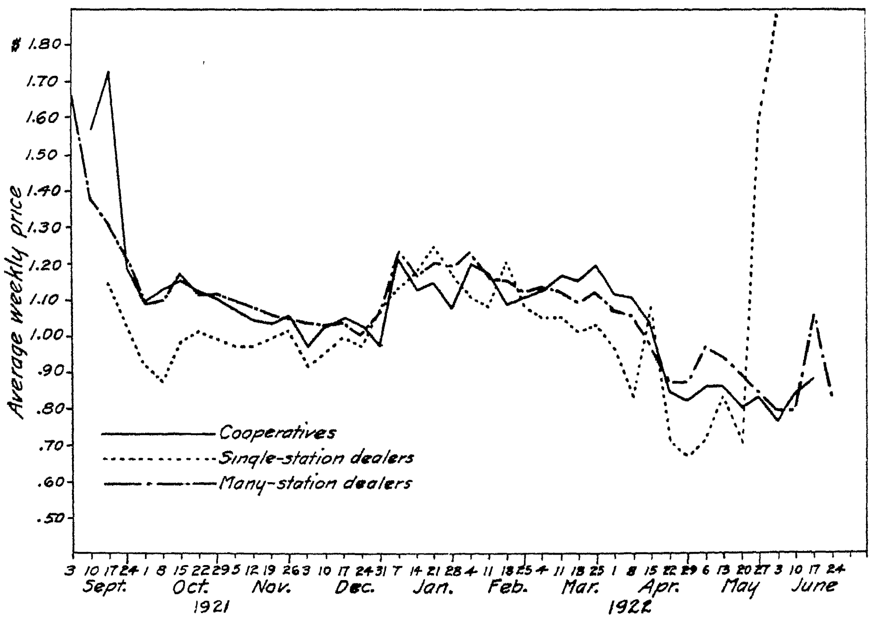

FIGURE 45. NET WHOLESALE PRICES PER BUSHEL RECEIVED F. O. B. SHIPPING POINT, 24 SHIPPING AGENCIES, SEASON, 1921–22

Early in the season, the cooperatives seem to have received the best prices; but from the beginning of the heavy shipping season to the end of the season, there was little difference in this respect between the cooperatives and the many-station dealers. The single-station dealers netted much lower prices throughout the heavy shipping season and toward the end. Only for a relatively short period during the middle of the season did the net wholesale prices for the single-station dealers approach those of the cooperatives and the many-station dealers.[17]

[17] The actual prices paid weekly are given in the appendix (page 166).

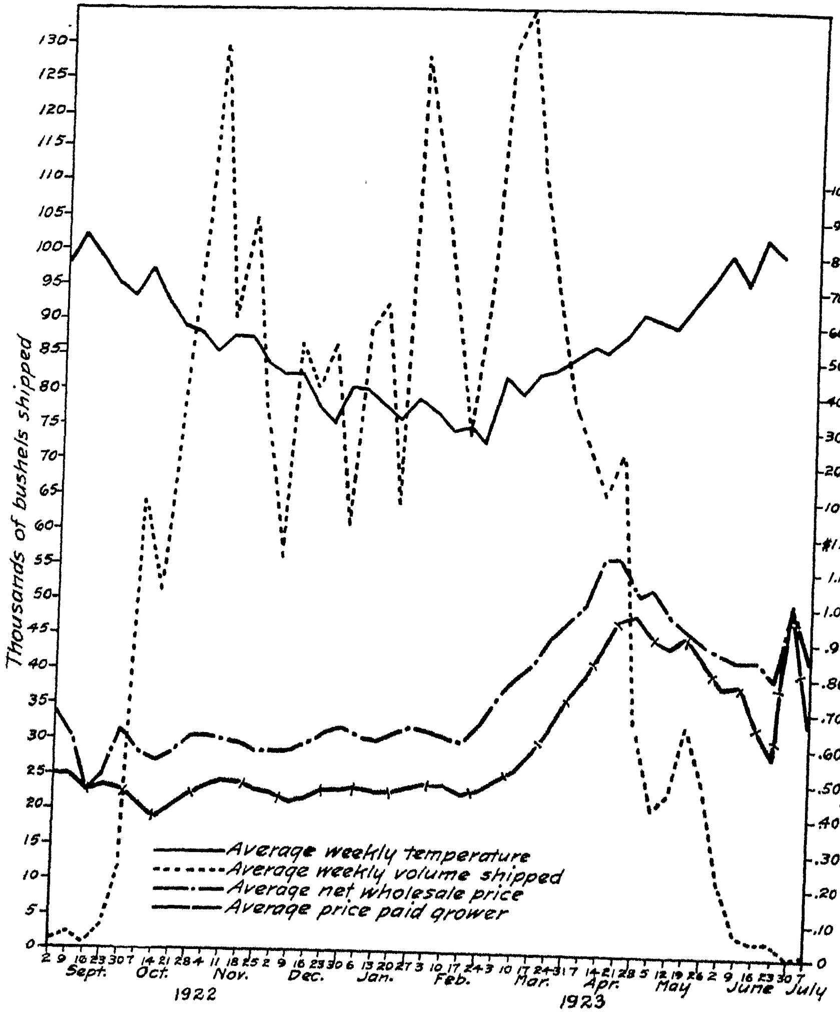

FIGURE 46. WEEKLY VOLUME SHIPPED, TEMPERATURE, NET WHOLESALE PRICE, AND PRICE PAID TO GROWER. THIRTY-FOUR SHIPPING AGENCIES, SEASON 1922–23

SEASON 1922–23

There were no less than three periods during the 1922–23 season when haulings approached peak proportions (figure 46). The first period began about September 30 and ended about December 2; the second period began about December 30 and ended about February 17; and the third period was from February 17 to March 31. During the first period, 27 per cent of the total volume was shipped, during the second period 24 per cent, and during the third period 23 per cent.

It is difficult to account satisfactorily for these peak loadings. The price started relatively low early in the season, and growers were not very anxious to sell. The heavy loadings during October and November were probably due to sales by growers who were obliged to sell their potatoes because of a lack of storage space or for financial reasons. It is possible that the need of money for the holidays and for taxes would largely account for the heavy haulings from December 30 to January 17. The increase in price was so slight that it could hardly have been a substantial factor. Prices started to rise comparatively rapidly from February 17 to April 14, and this condition apparently had the effect of bringing about the heaviest loadings of the season. Although prices remained relatively high until the end of the season, the bulk of the crop had been sold by April 14.

In general, the loadings by many-station dealers followed substantially the course outlined in the preceding paragraphs (figure 47). The twelve

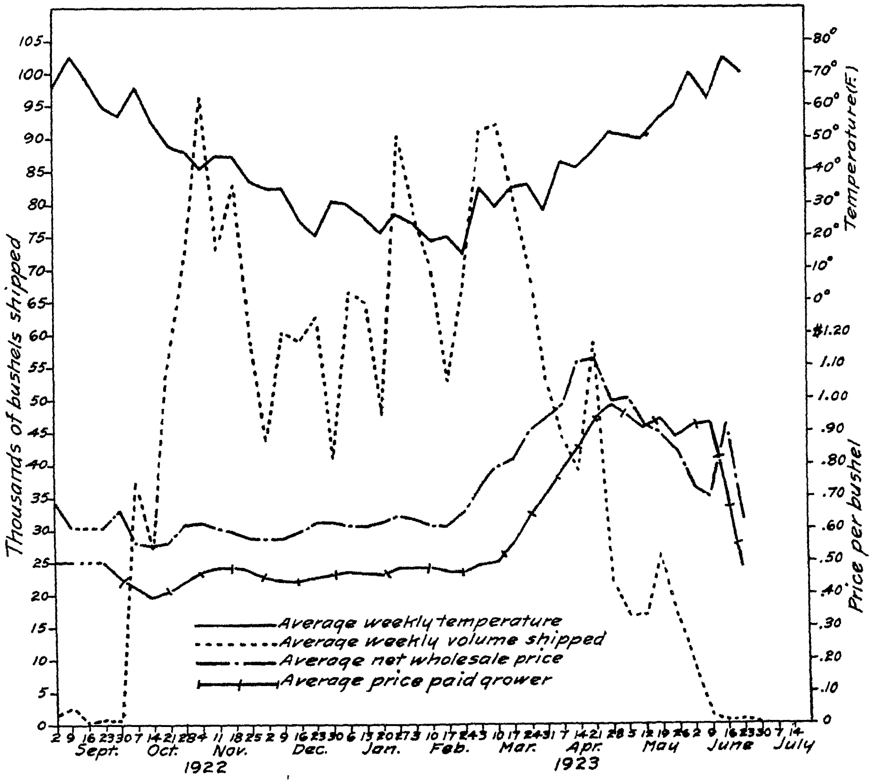

Figure 47. Weekly volume shipped, temperature, net wholesale price, and price paid to grower. Many-station dealers, season 1922–23

cooperatives were again the type of agency which approached most nearly to "feeding the market." Their loadings were comparatively even throughout the season, but were rather insignificant in volume at

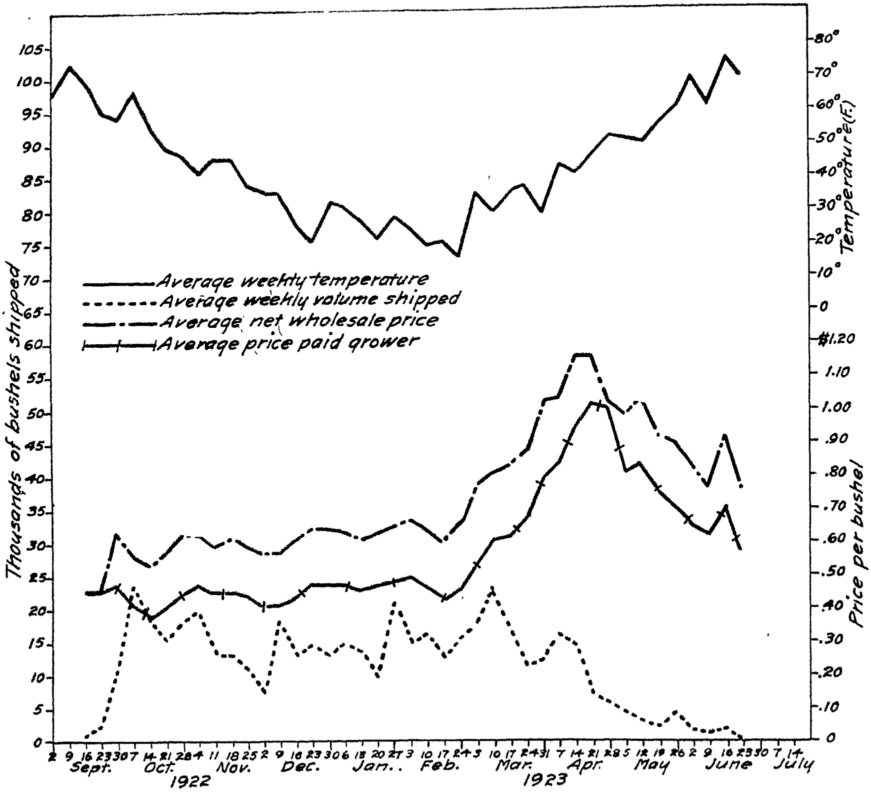

FIGURE 48. WEEKLY VOLUME SHIPPED, TEMPERATURE, NET WHOLESALE PRICE, AND PRICE PAID TO GROWER. COOPERATIVES, SEASON 1922–23

the time when prices were the highest (figure 48). The single-station dealers loaded a smaller amount during the early part of the season (figure 49), and managed to get a fair proportion of their volume on the market during the period of relatively high prices.

If all of these types of agencies had practiced a "feed-the-market" policy, they would probably have realized somewhat higher average prices for the year as a result of the upward trend of prices toward the end of the season. On the other hand, they might have lost considerably as a result of sharp drops in prices during May and June (figure 50).

From the standpoint of the prices paid to the growers, there was very little difference between these types of agencies up to March 14. All of them paid within 2 or 3 cents per bushel of the same price during the six months prior to that date. The cooperatives paid the growers from 4 to 8 cents more per bushel than did the single-station dealers from March 14 to the end of the season (figure 51). The many-station dealers paid the lowest prices during this period.[18]

[18] The actual prices paid weekly are given in the appendix (page 166).

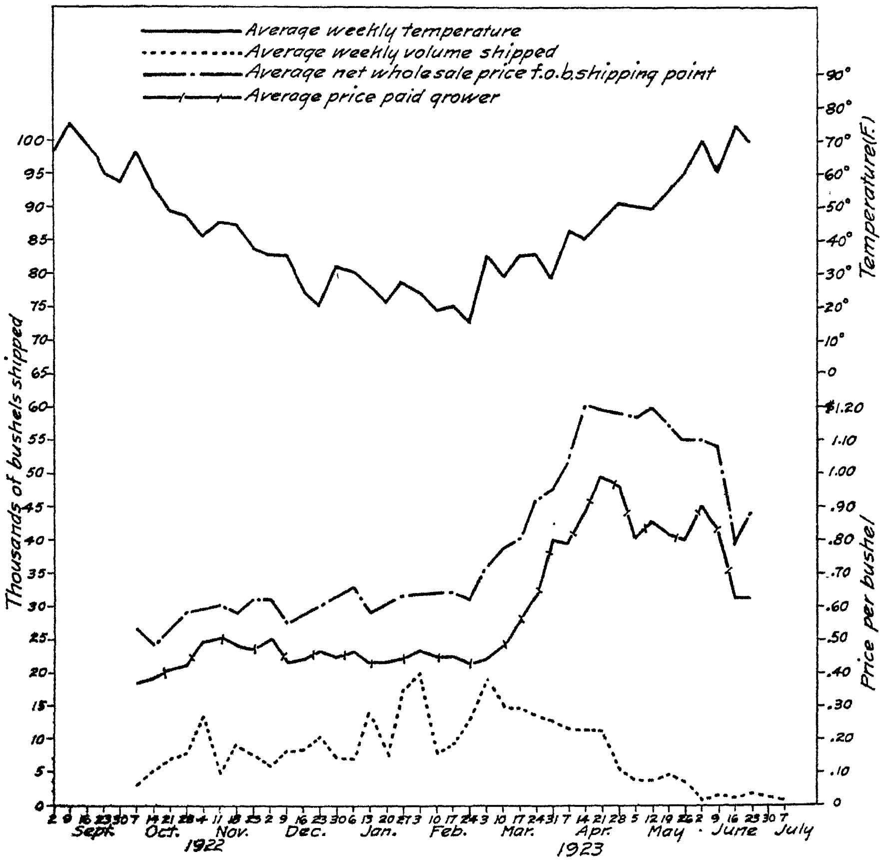

FIGURE 49. WEEKLY VOLUME SHIPPED, TEMPERATURE, NET WHOLESALE PRICE, AND PRICE PAID TO GROWER. SINGLE-STATION DEALERS, SEASON 1922–23

From the standpoint of the net wholesale prices (figure 52), there was likewise very little difference between the three types of agencies during the first six months of the season. From March 14 to the end of the season, the single-station dealers had the highest net price, the cooperatives were next in rank, and the many-station dealers were the lowest.

COSTS

BY OPERATIONS

None of the shipping agencies kept any sort of time records which would enable them to ascertain the cost of the various operations in the handling of potatoes. Practically all of the managers of the agencies had had considerable experience in the handling and shipping of potatoes, and were able to make very close estimates as to the time spent in the various operations. A questionnaire was sent to a number of loaders who were

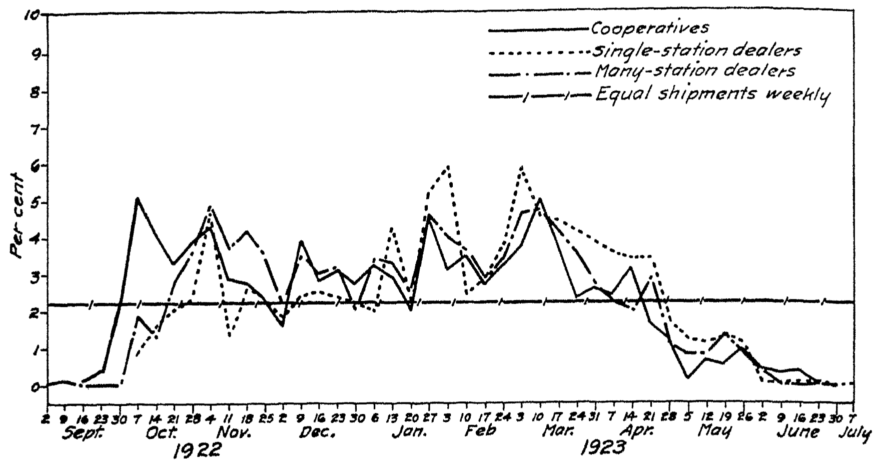

FIGURE 50. PERCENTAGE OF TOTAL VOLUME SHIPPED WEEKLY, COMPARED WITH EQUAL WEEKLY SHIPMENTS, 34 SHIPPING AGENCIES, SEASON 1922–23

employed by many-station dealers, and their estimates also were obtained. These estimates were not used in calculating costs for individual shippers, but were averaged for the entire number of shipping agencies. It was hoped that in this manner errors in estimating would balance one another. Care was taken in allocating expenses to the various operations, but the cost of each should be regarded only as an approximation. A comparison

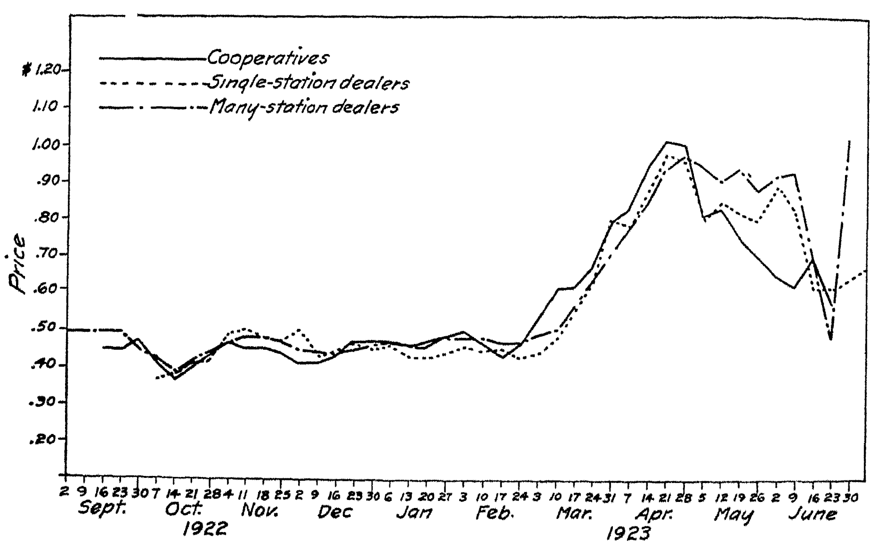

FIGURE 51. AVERAGE WEEKLY PRICE PER BUSHEL PAID TO GROWER, 34 SHIPPING AGENCIES, SEASON 1922–23

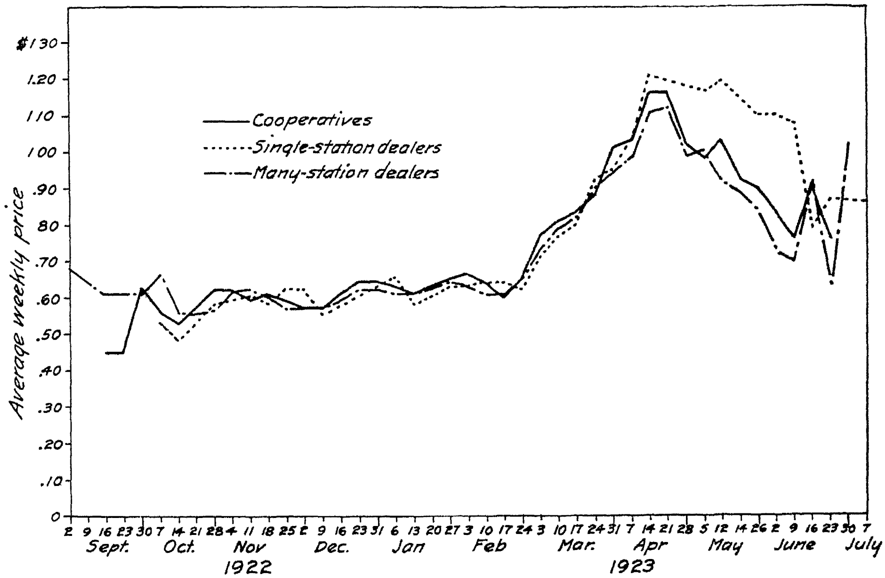

FIGURE 52. NET WHOLESALE PRICE PER BUSHEL RECEIVED F. O. B. SHIPPING POINT, 34 SHIPPING AGENCIES, SEASON 1922–23

of the costs in tabular form, with an average for the two seasons, is given in table 78. The average estimates used may be found in the appendix (page 165).

TABLE 78. COMPARISON OF AVERAGE COSTS PER BUSHEL, BY OPERATIONS, SEASONS 1921–22 AND 1922–23

Operation	Costs per bushel		
	Season 1921–22, 24 shipping agencies	Season 1922–23, 34 shipping agencies	Average for both seasons, 58 shipping agencies
Buying and selling	$0.02911	$0.02912	$0.02912
Grading and sacking	0.04201	0.04009	0.04105
Permanent storage	0.04823	0.07707	0.06265
Binning and sorting	0.04509	0.03715	0.04112
Preparing car	0.00709	0.00773	0.00741
Loading car, sacked	0 00824	0 00900	0.00862
Brokerage and commissions	0.01523	0.01946	0.01735
Sacks, tags, and twine	0.04104	0.04046	0.04075
Grading and loading, bulk	0.02531	0 03388	0.02960
Grading, sacking, and loading in sacks, total	0.09129	0.08955	0.09042

Season 1921-22

During the 1921–22 season, the average cost (not including brokerage or commissions) of buying and selling 3,516,143 bushels of potatoes was 2.911 cents per bushel. This cost really represents office overhead expenses per bushel.

The average cost of grading and sacking 2,818,715 bushels of potatoes was 4.201 cents per bushel.

Only a very small quantity of potatoes, 81,978 bushels, was stored. The average cost of storing was 4.823 cents (approximately 5 cents) per bushel, not including shrinkage or other losses.

Approximately one-sixth of the potatoes received were run into bins and then resorted before finally being sacked or loaded in bulk into a car. The average cost of binning and sorting potatoes in this manner was 4.509 cents per bushel. Green potatoes purchased in the early fall, which had to be rehandled in this way, were thus almost twice as expensive to handle as was mature stock received later in the year.

The cost of sweeping, lining, and heating cars amounted to 0.709 cent (approximately three-fourths of a cent) per bushel handled.

The cost of loading sacked potatoes into a car amounted to 0.824 cent (approximately four-fifths of a cent) per bushel.

The cost of grading and loading potatoes in bulk was slightly less than that of loading in sacks (excluding the cost of sacks, tags, and twine). On the average, the cost of grading and loading potatoes in bulk amounted to 2.531 cents per bushel, as compared with a cost of 4.201 cents per bushel for grading and sacking — a difference of 1.7 cents per bushel in favor of loading in bulk.

The cost of sacks, tags, and twine for the 2,818,715 bushels shipped in sacks amounted to 4.104 cents per bushel. This cost added to the cost of grading, sacking, and loading, made a total cost for these items (including sacks, tags, and twine) of 9.129 cents per bushel. It would seem necessary, then, that the price should have been at least 6.67 cents per bushel higher for sacked stock than for stock sold in bulk, if the process of sacking were to prove profitable.

The expense incurred for brokerage and commissions in selling these potatoes amounted to 1.523 cents per bushel.

Other costs, such as bad debts, inspection, trucking, and the like, amounted to 0.957 cent (approximately 1 cent) per bushel.

It should not be inferred that all of the potatoes handled by any one dealer passed through each one of the processes named. Some potatoes were graded directly into sacks, and so sold and shipped; some were graded and loaded in bulk; some were graded into bins and regraded before shipment; a few were stored for the winter. In so far as was possible, the foregoing costs were calculated for the actual volume which passed through each process. The volume shipped was determined from the actual carload records and from the estimates of the loaders.

Season 1922-23

During the 1922–23 season, the average cost (not including brokerage and commissions) of buying and selling 2,776,012 bushels of potatoes

was 2.912 cents (approximately 3 cents) per bushel. This compared closely with the cost for the same process during the 1921–22 season.

A total of 2,284,514 bushels of potatoes were graded and sacked at an average cost of 4.009 cents per bushel. This was about one-fifth of a cent less per bushel than the cost in 1921–22.

Fewer potatoes were stored for the winter in 1922–23, but the cost of storing 55,782 bushels was 7.707 cents per bushel, almost 2.9 cents more than in the previous season. These costs do not include loss from shrinkage.

Approximately one-fifth of the potatoes received were graded and placed in bins, and then resorted before finally being sacked or loaded in bulk and shipped. The average cost of putting 545,875 bushels of potatoes through this process was 3.715 cents per bushel. This compares with a cost of 4.5 cents per bushel in the 1921–22 season.

Not all the cars were heated, but most of them were swept and were lined with building paper or straw, or in some cases with lumber. The expense of thus preparing the cars averaged 0.773 cent per bushel. This cost was nearly the same as for the preceding season.

The cost of loading sacked potatoes averaged 0.9 cent per bushel. This compares with a cost of 0.824 cent for the same service in 1921-22.

On the average, the cost of grading and loading potatoes in bulk was slightly less than that of loading in sacks, being 3.388 cents (about 3.4 cents) per bushel as compared with 4.009 cents for grading and sacking. The extra cost of loading the sacked potatoes, 0.9 cent per bushel, must also be added. This makes a total cost for grading, sacking, and loading (exclusive of sacks, tags, and twine) of 4.909 cents per bushel, as compared with 3.388 cents per bushel for bulk potatoes — a difference in favor of the bulk method of 1.521 cents per bushel.

The cost of sacks, tags, and twine amounted to 4.046 cents per bushel. This cost added to the cost for grading, loading, and sacking (4.909 cents per bushel), made the total cost for these items 8.955 cents per bushel. During this season, the price should have been at least 5.5 cents per bushel higher for sacked stock than for bulk stock if expenses of sacking were to be met.

The average expense for brokerage and commissions amounted to 1.946 cents (approximately 2 cents) per bushel.

COMPARISONS OF COSTS

The relatively small number of records available limits the accuracy of comparisons of average costs and returns from the three types of agencies studied. It may be worth while to make such a comparison, however, with full recognition of its limitations.

Season 1921–22

The average group operating costs and returns for each type of marketing agency, as well as for groups by location, for the 1921–22 season, are shown in table 79.

TABLE 79. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 24 SHIPPING AGENCIES, SEASON 1921–22

Groups	Average for					
	7 farmers' cooperative associations	8 single-station dealers	9 many-station dealers	24 shipping agencies	9 northern New York shipping agencies	15 western New York shipping agencies
Labor and management	$27.92	$26.75	$29.05	$28.64	$27.22	$28.86
Warehouse costs	6.07	4.28	6.55	6.22	4.94	6.43
Equipment costs	1.09	0.68	1.10	1.05	0.71	1.10
General office costs	7.26	8.68	8.47	8.35	10.19	8.06
Telephone and telegraph	1.36	1.89	3.52	3.07	1.94	3.25
Bank exchange	1.11	0.79	1.19	1.13	0.79	1.18
Brokerage and commissions	11.46	16.30	7.37	8.93	15.36	7.91
Linings	1.91	2.10	2.03	2.02	2.22	1.99
Sacks, tags, and twine	19.37	3.65	22.33	19.74	4.57	22.15
Miscellaneous	3.24	7.51	8.07	7.42	7.27	7.44
Total operating costs	$ 80.79	$ 72.63	$ 89.68	$ 86.57	$ 75.21	$ 88.37
Amount paid to growers	552.06	567.24	568.97	566.73	563.96	567.17
Total cost of potatoes to shipper	$632.85	$639.87	$658.65	$653.30	$639.17	$655.54
Gross sales	$747.93	$767.52	$764.07	$762.53	$760.76	$762.82
Claims and allowances	$ 9.55	$ 11.06	$ 11.30	$ 11.05	$ 10.21	$ 11.19
Freight	94.01	124.84	106.42	107.13	124.37	104.39
Net sales	$644.37	$631.62	$646.35	$644.35	$626.18	$647.24
Net profit	$11.52	....	....	....	....	....
Net loss	....	$8.25	$12.30	$8.95	$12.99	$8.30

The two items of chief interest in this table are the total operating costs and the amount paid to the grower. Producer and consumer alike are interested in having potatoes handled at the lowest cost possible at country shipping points. The averages given in the table indicate that the single-station dealers handled potatoes at the lowest cost during the 1921–22 season, $72.63 per 600-bushel carload. Cooperatives ranked second, with an average cost of $80.79 per carload. The many-station dealers had the highest handling cost, $89.68 per carload.

The grower, while interested in having his potatoes handled at a low cost, was primarily concerned with the price that he received for them. On the basis of returns to the grower, the many-station dealers held first rank, with an average price paid to the grower of $568.97 per 600-bushel carload, or 94.8 cents per bushel. The single-station dealers ranked second, with $567.24 per carload, or 94.5 cents per bushel. The cooperatives paid the grower an average of $552.06 per carload and had an average profit of $11.52 per carload, which might have been paid to the growers as patronage dividends. Excluding the possible dividends, several of which were paid, the average return to the grower by the cooperatives was approximately 92 cents per bushel; with the possible dividend added, the average price paid to the grower would have been 94 cents per bushel.

The many-station dealers were, on the whole, the best salesmen, having net sales of $646.35 per carload, as compared with $644.37 for the cooperatives and $631.62 for the single-station dealers. The single-station dealers actually sold their potatoes for the highest average price, but they were

obliged to pay higher freight charges than the other two types of agencies and actually netted less than the many-station dealers.

If the amount of claims and allowances per carload may be taken as a criterion, the cooperatives loaded their cars the most carefully. The cooperatives held down their claims and allowances to $9.55 per carload, while the claims for single-station dealers averaged $11.06, and for many-station dealers $11.30.

In view of their operating costs and actual net sales, both the single-stat on dealers and the many-station dealers appear to have overpaid the grower by from 1.37 to 1.72 cents per bushel in 1921–22. This figure may seem relatively insignificant when expressed on a bushel basis, but such an overpayment actually resulted in net losses to one many-station dealer of $13,639.70

The two columns at the right in table 79 afford a basis of comparison for agencies located in western New York with those in northern New York. Labor and management constituted, on the average, slightly more than 33 per cent of the average total operating costs for these agencies in 1921–22. The other large items were sacks, tags, and twine, 22.8 per cent; brokerage and commissions, 10.32 per cent; and general office costs, 9.65 per cent. (Table 80.)

TABLE 80. GROUP OPERATING COSTS AS PERCENTAGES OF TOTAL OPERATING COSTS, AVERAGES FOR ALL AGENCIES, SEASON 1921–22

Groups	Average for western New York shippers (per cent)	Average for northern New York shippers (per cent)	Average for western and northern New York shippers (per cent)
Labor and management	32.66	36.20	33.08
Warehouse costs	7.27	6.56	7.19
Equipment costs	1.25	0.94	1.21
General office costs	9.12	13.54	9.65
Telephone and telegraph	3.67	2.58	3.54
Bank exchange	1.34	1.06	1.30
Brokerage and commission	8.96	20.42	10.32
Linings	2.26	2.95	2.34
Sacks, tags, and twine	25.06	6.07	22.80
Miscellaneous	8.41	9.68	8.57

These twenty-four agencies paid an average of $4.44 for labor and management for every $100 of net sales. The next largest item of operating cost was sacks, tags, and twine, which averaged $3.06 for every $100 of net sales; brokerage and commissions took $1.39; and general office costs took $1.30. The total average operating costs averaged $13.43 for every $100 of net sales, and $1.72 was allowed for claims and allowances. (Table 81.)

TABLE 81. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, AVERAGES FOR ALL AGENCIES, SEASON 1921–22

Groups	Average for western New York shippers (per cent)	Average for northern New York shippers (per cent)	Average for western and northern New York shippers (per cent)
Labor and management	4.46	4.35	4.44
Warehouse costs	0.99	0.79	0.97
Equipment costs	0.17	0.11	0.16
General office costs	1.25	1.63	1.30
Telephone and telegraph	0.50	0.31	0.47
Bank exchange	0.18	0.13	0.18
Brokerage and commissions	1 22	2.45	1.39
Linings	0.31	0 35	0.31
Sacks, tags, and twine	3 42	0.73	3.06
Miscellaneous	1.15	1.16	1.15
Total operating costs	13.65	12.01	13.43
Claims and allowances	1 73	1.63	1.72

A combination of all the score cards worked out for each type of agency gives some indication of the relative efficiency of the three types. The results are given in tables 82 and 83.

TABLE 82. RELATIVE RANK IN EFFICIENCY ON COSTS, AND ON CLAIMS AND ALLOWANCES, 24 SHIPPING AGENCIES, SEASON 1921–22*

Rank in efficiency	Score	Record no.	Agency
1	568	27	Single-station dealer
2	672	2	Cooperative
3	701	55	Many-station dealer
4	710	4	Cooperative
5	736	30	Single-station dealer
6	775	7	Cooperative
7	785	3	Cooperative
8	793	28	Single-station dealer
9	817	33	Single-station dealer
10	829	51	Many-station dealer
11	888	6	Cooperative
12	961	31	Single-station dealer
13	934	52	Many-station dealer
14	966	60	Many-station dealer
15	[1,018	57	Many-station dealer
16	1,050	53	Many-station dealer
17	1,079	54	Many-station dealer
18	1,083	53	Many-station dealer
19	1,115	26	Single-station dealer
20	1,147	5	Cooperative
21	1,157	1	Cooperative
22	1,158	29	Single-station dealer
23	1,183	56	Many-station dealer
24	1,413	32	Single-station dealer

* The lowest score is the most efficient. Average = 1000.

The shipping agency with the greatest efficiency on costs and on claims and allowances was a single-station dealer, no. 27; the agency with the poorest rating in efficiency was also a single-station dealer, no. 32 (table 82). There were four single-station dealers, four cooperatives, and two many station dealers, among the ten agencies ranking highest in efficiency on costs and on claims and allowances. Among the five agencies showing the lowest efficiency there were two single-station dealers, two cooperatives, and one many-station dealer. The many-station dealers seem to have been less efficient in costs and in claims and allowances during the 1921–22 season, than either the single-station dealers or the cooperatives, these agencies being about equal in this respect.

TABLE 83. RELATIVE RANK IN EFFICIENCY ON RETURNS, 24 SHIPPING AGENCIES, SEASON 1921–22*

Rank in efficiency	Score	Record no.	Agency
1	257	28	Single-station dealer
2	213	31	Sinlge-station dealer
3	212	3	Cooperative
4	206	51	Many-station dealer
5	204	58	Many-station dealer
6	202	7	Cooperative
7	202	6	Cooperative
8	202	56	Many-station dealer
9	202	53	Many-station dealer
10	200	2	Cooperative
11	200	55	Many-station dealer
12	199	54	Many-station dealer
13	198	60	Many-station dealer
14	195	4	Cooperative
15	195	57	Many-station dealer
16	194	52	Many-station dealer
17	192	5	Cooperative
18	191	1	Cooperative
19	187	32	Single-station dealer
20	184	26	Single-station dealer
21	182	27	Single-station dealer
22	180	30	Single-station dealer
23	171	29	Single-station dealer
24	171	33	Single-station dealer

* The highest score is the most efficient. Average = 200

The shipping agency with the greatest eff ciency on returns was likewise a single-station dealer, no 28, but not the same dealer who was the most efficient in costs. The agency with the poorest rating on returns was also a single-station dealer, no 33. There were four cooperatives, four many-station dealers, and two single-station dealers among the ten agencies ranking highest in efficiency on returns. The five agencies showing the lowest efficiency on returns were all single-station dealers. The many-station dealers and the cooperatives seem to have been on an approximate equality in efficiency on returns, and the single-station dealers were the least efficient type of agency, in 1921–22. (Table 83.)

Season 1922–23

The average group operating costs and returns for each type of marketing agency for the 1922–23 season are shown in table 84. The averages in this table indicate that the many-station dealers handled potatoes at the lowest cost during this season, $90.90 per carload. The single-station dealers had the next lowest cost, $99.84 per carload. The cooperatives had the highest cost, $100.53 per carload. The single-station dealers and the cooperatives were about equally efficient in costs, there being a difference of only 69 cents per carload between them. The many-station dealers were, on the average, about 10 per cent more efficient on costs during the 1922–23 season than the other two types of agencies.

TABLE 84. GROUP OPERATING COSTS AND RETURNS PER 600-BUSHEL CARLOAD, 34 SHIPPING AGENCIES, SEASON 1922–23

Groups	Average for					
	12 farmers' cooperative associations	10 single-station dealers	12 many-station dealers	34 shipping agencies	25 western New York shipping agencies	9 northern New York shipping agencies
Labor and management	$26.79	$29 50	$27.99	$28 00	$27.13	$32.81
Warehouse costs	7 59	5.71	6.28	6 42	6 43	6.43
Equipment costs	1 82	0.86	1.22	1 27	1.37	0 74
General office costs	10.83	12.06	9.81	10 27	9.57	14 28
Telephone and telegraph	1.27	1 91	3 22	2 72	2.90	1 69
Bank exchange	0 71	1.28	0.80	0.84	0.71	1.59
Brokerage and commissions	15 94	24 58	7.90	11 40	8 18	29.62
Linings	1.94	2 80	1 95	2.06	1.94	2.76
Sacks, tags, and twine	26 15	11.47	24.13	22 84	25 50	7.76
Miscellaneous	7 49	9 67	7 60	7.85	7.06	12 30
Total operating costs	$100.53	$ 99.84	$ 90.90	$ 93 67	$ 90.79	$109.98
Amount paid to growers	317.01	337.28	321.44	322.73	315.16	365.56
Total cost of potatoes to shipper	$417.54	$437 12	$412 34	$416.41	$405.95	$475.54
Gross sales	$526 66	$564 44	$512.50	$521 58	$508.04	$598.17
Claims and allowances	$ 9.59	$ 6 20	$ 6 94	$ 7.29	$ 7 67	$ 5.15
Freight	101 52	110 45	96.14	98 89	96.62	111.72
Net sales	$415.55	$447.79	$409 42	$415.40	$403 75	$481 30
Net profit	.	$10 67	. .	. . .	.	$5.76
Net loss	$1.99	. . .	$2.92	$1.01	$2 20	. . . . .

The situation was different, however, from the standpoint of returns to the grower. The single station dealers paid the growers $337.28 per carload, or about 56.2 cents per bushel; the many-station dealers paid the next highest return, $321.44 per carload, or 53.5 cents per bushel; and the cooperatives paid the growers the least, $317.01 per carload, or 52.8 cents per bushel.

The single-station dealers were, on the average, the best salesmen, since their sales per carload were $447.79 even after paying the high freight cost of $110.45. The cooperatives had the next highest net sales, $415.55 per carload; and the many-station dealers were lowest, with $409.42. The cooperatives and the many-station dealers apparently overpaid the growers, since they experienced losses of $1.99 and $2.92, respectively, per carload.

If the amount of claims and allowances per carload may be taken as a criterion, the single-station dealers loaded their cars most carefully in 1922–23. These dealers held down their claims and allowances to $6.20 per carload, as compared with $6.94 per carload for the many-station dealers and $9.59 per carload for the cooperatives.

The two columns at the right in table 84 afford a basis of comparison for agencies located in western New York with those in northern New York.

Labor and management constituted approximately 3 per cent less of the average total operating costs in 1922–23 than in 1921–22, the figures being 29.88 per cent in the second season as compared with 33.08 per cent in the first. Sacks, tags, and twine took a larger percentage in the second season, however, amounting to 24.38 per cent as compared with 22.8 per cent in 1921–22. Brokerage and commissions, and general office costs, also constituted larger percentages in the second season. (Table 85.)

TABLE 85. GROUP OPERATING COSTS AS PERCENTAGES OF TOTAL OPERATING COSTS, AVERAGES FOR ALL AGENCIES, SEASON 1922–23

Groups	Average for western New York shippers (per cent)	Average for northern New York shippers (per cent)	Average for western and northern New York shippers (per cent)
Labor and management	29.89	29.83	29.88
Warehouse costs	7.08	5.85	6.86
Equipment costs	1.51	0.67	1 36
General office costs	10.53	12.98	10.97
Telephone and telegraph	3.20	1.53	2 90
Bank exchange	0.78	1.45	0.90
Brokerage and commissions	9.01	26 94	12.17
Linings	2.13	2.51	2 20
Sacks, tags, and twine	28.09	7.05	24.38
Miscellaneous	7.78	11.19	8.38

Labor and management cost these thirty-four shipping agencies an average of $6.73 for every $100 dollars of net sales (table 86). This was $2.29 higher than the corresponding figure for 1921–22. Sacks, tags, and twine averaged $5.50 for every $100 of net sales, as compared with $3.06 in 1921–22; brokerage and commissions were also higher, being $2.74 as compared with $1.39 in 1921–22. The average total operating costs in 1922–23 amounted to $22.54 for every $100 of net sales, as compared with $13.43 for the 1921–22 season. Claims and allowances, however, were but 3 cents higher during the second season. The greatly reduced net sales price per carload in 1922–23, $415.40 as compared with $644.35 in the previous season, would account for most of these differences.

TABLE 86. GROUP OPERATING COSTS AS PERCENTAGES OF NET SALES, AVERAGES FOR ALL AGENCIES, SEASON 1922–23

Groups	Average for western New York shippers (per cent)	Average for northern New York shippers (per cent)	Average for western and northern New York shippers (per cent)
Labor and management	6 72	6 82	6 73
Warehouse costs	1.59	1.34	1.55
Equipment costs	0.34	0 15	0 31
General office costs	2.37	2 97	2.47
Telephone and telegraph	0.72	0.35	0.65
Bank exchange	0 18	0 33	0.20
Brokerage and commissions	2 02	6 16	2 74
Linings	0 48	0 57	0 50
Sacks, tags, and twine	6 31	1.61	5.50
Miscellaneous	1 75	2 56	1 89
Total operating costs	22.48	22.85	22.54
Claims and allowances	1.90	1.07	1.75

The results of a combination of score cards worked out for each type of agency are given in tables 87 and 88.

The ten agencies ranking highest in efficiency on costs and on claims and allowances (table 87) included five many-station dealers, three single-station dealers, and two cooperatives. The ten agencies ranking lowest

TABLE 87. RELATIVE RANK IN EFFICIENCY ON COSTS, AND ON CLAIMS AND ALLOWANCES, 34 SHIPPING AGENCIES, SEASON 1922–23*

Rank in efficiency	Score	Record no.	Agency
1	750	155	Many-station dealer
2	760	152	Many-station dealer
3	813	159	Many-station dealer
4	822	137	Single-station dealer
5	840	136	Single-station dealer
6	863	103	Cooperative
7	867	102	Cooperative
8	913	129	Single-station dealer
9	917	163	Many-station dealer
10	934	156	Many-station dealer
11	940	127	Single-station dealer
12	949	134	Single-station dealer
13	963	157	Many-station dealer
14	967	104	Cooperative
15	977	160	Many-station dealer
16	977	107	Cooperative
17	1,002	101	Cooperative
18	1,010	130	Single-station dealer
19	1,026	154	Many-station dealer
20	1,035	112	Cooperative
21	1,047	111	Cooperative
22	1,063	151	Many-station dealer

TABLE 87 (*concluded*)

Rank in efficiency	Score	Record no.	Agency
23	1,070	128	Single-station dealer
24	1,090	158	Many-station dealer
25	1,105	131	Single-station dealer
26	1,183	164	Many-station dealer
27	1,192	106	Cooperative
28	1,240	105	Cooperative
29	1,249	110	Cooperative
30	1,381	126	Single-station dealer
31	1,428	109	Cooperative
32	1,444	162	Many-station dealer
33	1,584	135	Single-station dealer
34	1,592	108	Cooperative

* The lowest score is the most efficient. Average = 1000.

included five cooperatives, three single-station dealers, and two many-station dealers. There was no one type of agency outstandingly efficient The most efficient individual agency was a many-station dealer; the least efficient was a cooperative; but representatives of all three types of agencies were well distributed in rank throughout the whole list.

The ten agencies ranking highest in efficiency on returns (table 88 included four many-station dealers, four single-station dealers, and two cooperatives. The ten agencies ranking lowest included six cooperatives, three single-station dealers, and one many-station dealer. The agency with the highest efficiency on returns was a cooperative, as was also the agency with the lowest efficiency on returns.

TABLE 88. RELATIVE RANK IN EFFICIENCY ON RETURNS, 34 SHIPPING AGENCIES, SEASON, 1922–23*

Rank in efficiency	Score	Record no.	Agency
1	290	105	Cooperative
2	276	131	Single-station dealer
3	252	112	Cooperative
4	242	162	Many-station dealer
5	234	128	Single-station dealer
6	230	127	Single-station dealer
7	225	126	Single-station dealer
8	216	152	Many-station dealer
9	213	160	Many-station dealer
10	210	156	Many-station dealer
11	210	130	Single-station dealer
12	208	163	Many-station dealer
13	204	110	Cooperative
14	201	136	Single-station dealer
15	197	102	Cooperative
16	196	164	Many-station dealer

* The highest score is the most efficient. Average = 200.

TABLE 88 (*concluded*)

Rank in efficiency	Score	Record no.	Agency
17	194	154	Many-station dealer
18	194	108	Cooperative
19	190	157	Many-station dealer
20	189	151	Many-station dealer
21	189	155	Many-station dealer
22	188	159	Many-station dealer
23	188	129	Single-station dealer
24	186	104	Cooperative
25	186	134	Single-station dealer
26	186	158	Many-station dealer
27	182	103	Cooperative
28	182	137	Single-station dealer
29	179	111	Cooperative
30	178	106	Cooperative
31	176	107	Cooperative
32	175	101	Cooperative
33	175	135	Single-station dealer
34	153	109	Cooperative

Since the principle of cooperative marketing is operation at cost, these marketing associations can pay back to the growers only the actual net returns received. Assuming equal efficiency, in a year when dealers generally lost money it would be expected that cooperatives would return lower average prices to the growers.

CONCLUSIONS

It would be difficult to state which of the three types of agencies here discussed performed most efficiently and economically the necessary services incident to receiving and shipping potatoes. Each type had outstanding individual representatives who operated efficiently; each likewise had inefficient representatives. The type of agency is probably not the most important factor. The primary concern is that the agency, of whatever type it may be, shall follow good business principles and be efficiently managed. This seems as likely to occur in one type of agency as in another. It is probable that these three types supplement one another very well and provide the kind of competition necessary to call forth the best efforts for efficiency and economy.

Lack of proper accounting is one of the weak features of the potato-shipping business. A few of the agencies studied were exceptions to this rule. Some did not make adequate allowances for depreciation of warehouses and equipment. Many went through the form of collecting what is called a reserve fund, and then used the fund for current expenses. It is particularly desirable that adequate reserves for depreciation and possible losses should be built up, to meet unfavorable situations. It is only fair to state that many of the shipping agencies realize the weakness of their accounting systems and invite suggestions for improvement. Several have spent large sums of money for systems that have not proved satisfactory.

Dealers and cooperatives alike are often asked to extend loans on potatoes which are as yet unharvested or are stored in the growers' cellars. Growers who ask loans of shipping agencies should recognize the fact that the shipping agency is not a bank and is not adapted for carrying on the credit function. The place to borrow money is a bank, not a cooperative association or a private dealer. The business of all shipping agencies is to handle and ship potatoes. The business of a bank is to sell credit. It is as logical to ask a bank to handle and ship potatoes, as to ask a cooperative or a private dealer to extend credit. If cooperatives or dealers are obliged to extend credit, they frequently have to borrow the necessary funds from a bank at the current rate of interest. Since there is always some risk in loaning money, the cooperatives or dealers, to be safe, have to charge more than the current rate of interest in order to avoid loss.

It is easy to make mistakes in any business, and that of potato shipping is no exception. Occasionally a cooperative or a dealer starts in business without any knowledge of the number of carloads shipped annually from the local station, or of the number which the shipper can reasonably hope to handle. So far as available data show, no cooperative in New York has, as yet, handled 100 per cent of the potatoes shipped from any station. The same is probably true of dealers. The manager of a prominent cooperative organization gives the sound advice that it is best to rent for a while, until the warehouse needs are better known. At any rate, before purchasing or building a warehouse it may be a good policy to ascertain the number of carloads of potatoes shipped from the local station over a period of years (page 155), and then estimate conservatively the number of carloads that the shipping agency can hope to handle. If less than from 30 to 50 carloads are to be handled annually, it is doubtful whether the acquiring of a warehouse can be justified. In such a situation, car-door loading will probably work out more advantageously.

Only a small number of the shipping agencies use their warehouses throughout the year. During the winter, potatoes are hauled at very irregular intervals; and there is much idle time in both winter and summer, and some idle space in warehouses. Certain of the shipping agencies are now handling feed, fertilizer, lime, seed, and a variety of the agricultural products of their region; others are carrying on a very restricted business with only a few commodities. It is probable that the handling of some of the above-named farm supplies, as well as of most of the farm products that are raised in the region and that may be shipped in carloads, would aid in reducing overhead expenses. Several shipping agencies are interested in such a program, but are apprehensive of becoming involved in the extension of a great deal of credit to farmers. It is possible that trade acceptances may prove helpful in solving this problem. These are used widely in the larger centers, but have not as yet been generally used in rural districts. A feed store in southern New York seems to be using them successfully. If reliable farmers desire credit from this feed store, it is provided by these trade acceptances. These acceptances can run from one to three months and are not renewable. The firm operating the feed store charges 1 per cent interest per month on accounts for which acceptances are drawn. The acceptances are backed by the store and are discounted at the local bank. By this method the

farmer pays for his own credit and knows what he is paying for. The feed store gives acceptances only to farmers whose credit is good, and thus has all its capital available for carrying on its business. A blank copy of such an acceptance is shown in figure 53. Bankers are familiar with trade acceptances, and would probably be willing to assist shipping agencies in their use.

Trade Acceptances Are Approved By { National Association of Credit Men / American Bankers Association / Chamber of Commerce of the United States

Represented in the American Trade Acceptance Council

TRADE ACCEPTANCE

No.................. ....191..... $..............................

....................................after date pay to the order of..............................

....Dollars

The obligation of the Acceptor hereof arises out of the purchase of goods from the drawer.

To..

Due...................................191.... By...

Accepted .... Date .... Payable at .... Designated Bank or place of payment .... Location .... Signature of Acceptor ....

THIS IS YOUR COPY

Make your record on the reverse side and detach before returning acceptance

A TRADE ACCEPTANCE

Is an acknowledgment of a debt by the buyer in favor of the seller, for merchandise that the seller has placed in the hands of the buyer. The buyer agrees, in writing across the face of this acceptance his name, the name and location of his own bank and the date, to pay the amount of this certain indebtedness at a certain time at his own bank.

This varies from the open book account method only in giving the debt a negotiable value. The Federal Reserve Banks strongly urge the use of the trade acceptance, and state that the signing of an acceptance increases the financial standing of the signer, because it shows prompt paying methods.

Kindly write in the name of your bank and town, and sign across the face of the acceptance on the lines indicated. Make your own record on the reverse side of this sheet, detach and mail the acceptance to us.

....

FIGURE 53. FORM OF TRADE ACCEPTANCE USED BY A FEED STORE IN SOUTHERN NEW YORK

APPENDIX

DATA ON CARLOAD SHIPMENTS OF NEW YORK POTATOES

The data given in table 89 were compiled by the Bureau of Agricultural Economics, United States Department of Agriculture, with the assistance of division superintendents of the railroads over which the potatoes were shipped. Daily reports were made by station agents to superintendents of divisions concerning the produce shipped from each station. These reports were summarized and were wired to the Bureau of Agricultural Economics at Washington, D. C., where all of the data were compiled. These data have not been published, and are used in this study through the courtesy of the Bureau of Agricultural Economics.

TABLE 89. CARLOT SHIPMENTS OF NEW YORK WHITE POTATOES, SEASONS 1922–23, 1921–22, 1920–21

County	Station	Number of carloads		
		In 1922–23	In 1921–22	In 1920–21
Albany	*	1	......	......
Allegany	Alfred	20	49	20
	Almond	26	53	26
	Andover	207	330	191
	Angelica	32	74	22
	Belfast	......	15	......
	Belmont	25	20	16
	Birdsall	15	92	39
	Burns	......	......	11
	Canaseraga	120	233	148
	Caneadea	14	37	16
	Ceres	14	14	......
	Cuba	......	11	......
	Fillmore	99	159	79
	Rossburg	12	31	......
	Scio	28	26	17
	Swain	32	69	21
	Wellsville	207	273	166
	Whitesville	118	169	111
	Other stations*	27	10	32
	Total for Allegany County	996	1,665	915
Bronx	*	......	1	......
Broome	Center Village	......	36	29
	Lisle	......	11	12
	Nineveh	......	18	0
	Whitney Point	......	14	10
	Other stations*	16	10	11
	Total for Broome County	16	89	62
Cattaraugus	Delevan	......	26	......
	Farmerville	......	20	......
	Freedom	12	29	......
	West Valley	18	22	......
	Other stations*	22	38	36
	Total for Cattaraugus County	52	135	36

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads In 1922–23	In 1921–22	In 1921–20
Cayuga	Auburn	22	24	23
	Cato	13	10	13
	Crocketts		...	18
	Genoa	.	15	...
	Ira	10	.	
	Locke	14	30	28
	Moravia	55	78	69
	Sennett	31	29	27
	Weedsport	49	42	53
	Other stations*	32	24	43
	Total for Cayuga County	226	252	274
Chautauqua	*	16	30	25
Chemung	Erin	...	16	14
	Horseheads	...	...	10
	Mill Port	...	10	...
	Other stations*	16	31	25
	Total for Chemung County	16	57	49
Chenango	Afton	...	22	18
	Greene	...	10	...
	New Berlin	...	20	15
	Sherburne	28	51	34
	Smyrna	...	14	13
	Other stations*	12	16	11
	Total for Chenango County	40	133	91
Clinton	Cadyville	213	183	44
	Churubusco	56	126	38
	Ellenburg	116	102	75
	Peru	123	81	60
	Other stations*	7	2	165
	Total for Clinton County	515	494	382
Columbia	*	1	1	...
Cortland	Blodgett Mills	...	12	...
	Cincinnatus	...	49	26
	Cortland	25	46	51
	Cuyler	...	12	...
	East Freetown	...	12	...
	Homer	82	118	83
	Little York	13	30	28
	McGraw	...	22	21
	Marathon	23	57	39
	Messengerville	...	17	12

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads In 1922–23	In 1921–22	In 1920–21
Cortland (*continued*)	Mills	12	26	15
	North Harford	18	29	38
	Preble	24	23	23
	Truxton	17	33	22
	Other stations*	32	5	21
	Total for Cortland County	246	491	379
Delaware	Stamford	.	22	17
	Other stations*	10	10	4
	Total for Delaware County	10	32	21
Dutchess	*	2	4	4
Erie	Alden	26	23	...
	Chafee	.	22	...
	East Aurora	24	11	...
	Jewettville	12	...	
	Other stations*	60	31	15
	Total for Erie County	122	87	15
Essex	Bloomingdale	25	16	11
	Keeseville	11	...	...
	Port Kent	11	...	...
	Other stations*	13	21	9
	Total for Essex County	60	37	20
Franklin	Bangor	54	92	48
	Brushton	27	37	46
	Burke	65	126	57
	Chateaugay	199	335	191
	Constable	.	10	...
	Gabriels	38	24	26
	Malone	132	240	42
	Owls Head	...	21	15
	Other stations*	19	20	60
	Total for Franklin County	534	905	485
Genesee	Alabama	45	26	33
	Alexander	10	...	...
	Batavia	141	116	69
	Bergen	42	12	13
	Byron	110	59	60
	Corfu	10	...	...
	Darien Center	51	34	11
	East Bethany	34	32	16
	East Pembroke	65	66	22
	Elba	105	46	48
	Le Roy	78	27	48

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads In 1922–23	In 1921–22	In 1920–21
Genesee (*continued*)	North Le Roy	46	15	10
	Oakfield	54	47	24
	Pavilion	22	....	....
	South Byron	98	62	50
	Stafford	165	116	126
	Wheatville	23	....	....
	Other stations*	38	29	12
	Total for Genesee County	1,137	687	542
Herkimer	*	....	8	1
Jefferson	*	....	1	....
Lewis	Lowville	....	....	12
	Other stations*	2	....	8
	Total for Lewis County	2	0	20
Livingston	Avon	47	15	41
	Caledonia	30	....	28
	Conesus	12	14	....
	Dalton	41	64	35
	Dansville	145	167	142
	Fowlerville	18	....	....
	Hemlock	45	14	34
	Lakeville	20	....	....
	Lima	62	19	59
	Linwood	13	....	14
	Livonia	40	25	37
	Livonia Station	25	....	16
	Montear	20	39	22
	Nunda	25	12	....
	South Lima	12	....	14
	South Livonia	....	....	12
	Springwater	75	107	80
	Websters	53	80	25
	Other stations*	30	39	34
	Total for Livingston County	713	595	593
Madison	DeRuyter	23	48	28
	North Brookfield	....	14	....
	Sheds Corners	....	....	11
	Other stations*	16	58	27
	Total for Madison County	39	120	66
Monroe	Adams Basin	17	....	....
	Brighton	....	21	....
	Brockport	10	12	....
	Chili	25	....	13

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads In 1922–23	In 1921–22	In 1920–21
Monroe (*continued*)	Churchville	64	25	18
	Fairport	66	14	60
	Henrietta	34	11	55
	Honeoye Falls	142	60	130
	Industry	17	....	....
	Mendon	101	60	108
	Mumford	43	17	23
	Pittsford	123	32	93
	Rochester	....	42	....
	Rochester Junction	44	23	39
	Rush	76	28	77
	Scottsville	66	15	18
	Spencerport	41	23	54
	Wadsworth	24	....	10
	Waynesport	....	25	44
	Webster	118	13	12
	West Henrietta	61	18	32
	West Rush	10	....	14
	Other stations*	37	28	26
	Total for Monroe County	1,119	467	826
Nassau	*	6	9	7
Niagara	*	2	1	1
Oneida	Franklin Springs	....	11	....
	Paris	....	11	....
	Richfield Junction	....	21	....
	Waterville	....	21	....
	Other stations*	12	45	27
	Total for Oneida County	12	109	27
Onondaga	Apulia	10	27	11
	Baldwinsville	33	35	60
	Half Way	17	17	27
	Jamesville	....	....	10
	Jordan	17	28	29
	Kirkville	....	....	10
	Lamson	....	17	19
	Marcellus	49	70	69
	Memphis	....	10	25
	Onatavia	....	14	21
	Skaneateles	45	54	43
	Skaneateles Junction	42	44	23
	Tully	52	99	114
	Other stations*	37	63	59
	Total for Onondaga County	302	478	520
Ontario	Aloquin	13	....	13
	Canandaigua	29	12	17

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads In 1922–23	In 1921–22	In 1920–21
Ontario (*continued*)	Clifton Springs	114	60	100
	Farmington	47	17	45
	Fishers	87	36	69
	Holcomb	131	65	127
	Ionia	36	38	67
	Manchester	10	......	20
	Naples	182	219	210
	Oaks Corners	23	16	26
	Phelps	114	78	117
	Phelps Junction	94	27	85
	Seneca Castle	67	48	28
	Shortsville	15	...	...
	Victor	175	109	170
	West Bloomfield	25	.	14
	Other stations*	34	47	39
	Total for Ontario County	1,196	772	1,147
Orange	*	2	2	2
Orleans	Albion	12	12	12
	Eagle Harbor Station	......	......	13
	Knowlesville	46	45	40
	Other stations*	17	24	17
	Total for Orleans County	75	81	82
Oswego	Fulton	20	.....	30
	Kasoag	....	11	.....
	South Granby	24	24	33
	Other stations*	20	12	24
	Total for Oswego County	64	47	87
Otsego	Cooperstown	....	11	....
	East Worcester	24	38	25
	Edmeston	....	16	....
	Fly Creek	....	18	....
	Milford	26	37	34
	Schenevus	27	63	52
	Worcester	32	63	43
	Other stations*	17	31	18
	Total for Otsego County	126	277	172
Queens*	....	....	5	....
Rensselaer	*	15	4	10
St. Lawrence	North Lawrence	....	10	....
	Other stations*	6	4	6
	Total for St. Lawrence County	6	14	6

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads		
		In 1922–23	In 1921–22	In 1920–21
Saratoga	*	1	3	1
Schenectady	*	1	0	0
Schoharie	*	1	7	6
Schuyler	Alpine	....	15	......
	Beaver Dams	49	79	78
	Burdett	26	34	38
	Odessa	27	37	31
	Watkins	27	33	23
	Other stations*	15	18	21
	Total for Schuyler County	144	216	191
Seneca	Junius	29	18	31
	Waterloo	...	12	10
	Other stations*	6	11	12
	Total for Seneca County	35	41	53
Steuben	Addison	.....	24	17
	Arkport	186	224	201
	Atlanta	192	257	197
	Avoca	186	237	202
	Bath	48	90	65
	Cameron	16	24	16
	Cameron Mills	....	15	......
	Campbell	33	73	44
	Canisteo	40	54	129
	Cohocton	252	352	280
	Coopers	......	19	14
	Corning	.....	15	....
	Greenwood	67	55	49
	Hammondsport	32	37	34
	Hornell	83	202	146
	Kanona	48	87	58
	Portway	60	101	70
	Prattsburg	228	216	214
	Rexville	55	....	....
	Rogersville	144	217	165
	Savona	28	41	36
	Wallace	270	400	329
	Wayland	269	345	261
	Wayland Station	152	216	177
	Wheeler	85	101	88
	Other stations*	37	25	60
	Total for Steuben County	2,511	3,427	2,852
Suffolk	Amagansett	....	....	....
	Aqueboque	283	243	389
	Bridgehampton	783	631	591

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads In 1922–23	In 1921–22	In 1920–21
Suffolk (*continued*)	Calverton	520	408	385
	Cutchoque	551	316	411
	East Hampton	32	....	10
	Greenlawn	....	....	10
	Greenport	76	111	372
	Jamesport	510	338	448
	Laurel	201	140	144
	Manorville	12	....	10
	Mattituck	624	373	414
	Northport	10	16	23
	Peconic	251	274	278
	Port Jefferson	20	14	18
	Riverhead	1,041	749	868
	Southampton	370	260	241
	Southold	467	299	414
	Wading River	92	49	44
	Wainscott	263	155	158
	Water Mill	507	333	362
	By Mr. Stanton, L. I. R. R.	390	35	....
	(New London, Conn., for New York)	143	50	18
	Other stations*	39	37	33
	Total for Suffolk County	7,185	4,831	5,641
Sullivan	*	....	2	....
Tioga	Apalachin	....	53	19
	Berkshire	....	24	10
	Candor	12	44	31
	Flemingsville	....	16	11
	Newark Valley	....	39	13
	Nichols	50	90	58
	Owego	12	45	14
	Richford	19	53	35
	Spencer	....	13	....
	Tioga Center	....	12	....
	Other stations*	37	10	30
	Total for Tioga County	130	399	221
Tompkins	Besemer	....	28	21
	Dryden	61	128	69
	Etna	....	10	....
	Freeville	....	13	12
	Groton	....	15	11
	McLean	29	44	34
	South Lansing	....	....	10
	Trumansburg	14	24	24
	Other stations*	47	16	22
	Total for Tompkins County	151	278	203

* Having shipments of less than 10 cars.

TABLE 89 (*continued*)

County	Station	Number of carloads		
		In 1922–23	In 1921–22	In 1920–21
Ulster	*	......	....	1
Warren	*	......	....	1
Washington	Cambridge	15	....	18
	Fort Edward	....	....	10
	Granville	....	....	12
	Greenwich	45	45	35
	Salem	30	45	56
	Shushan	....	....	13
	Other stations*	12	31	18
	Total for Washington County	102	121	162
Wayne	Lyons	97	45	79
	Macedon	21	....	19
	Marion	21	12	29
	Newark	38	43	72
	North Macedon	10	....	....
	North Newark	10	....	21
	Palmyra	17	12	28
	Port Gibson	40	17	32
	Savannah	17	20	22
	Sodus Center	....	....	14
	Walworth	14	....	20
	Wayneport	35	....	....
	Other stations*	47	62	56
	Total for Wayne County	367	211	392
Westchester	*	....	1	....
Wyoming	Arcade	17	36	....
	Attica	52	20	....
	Bliss	116	210	63
	Castile	32	20	36
	Curriers	23	32	12
	Eagle	11	20	....
	Gainesville	228	216	116
	Hardys	160	206	84
	Java Center	64	81	47
	Johnsonburg	10	12	0
	North Java	51	116	33
	Portageville	19	38	....
	Rock Glen	74	99	54
	Silver Springs	....	15	14
	Varysburg	16	16	12
	Warsaw	78	62	27
	Other stations*	19	61	52
	Total for Wyoming County	970	1,260	550
Yates	Bellona	17	12	13
	Benton	....	15	31

* Having shipments of less than 10 cars.

TABLE 89 (*concluded*)

County	Station	Number of carloads		
		In 1922–23	In 1921–22	In 1920–21
Yates (*continued*)	Branchport..........	16	10	17
	Dundee..................	....	....	10
	Middlesex	27	23	32
	Penn Yan.......	....	....	17
	Other stations*	18	18	18
	Total for Yates County..	78	78	138
	Total for State..........	19,345	18,965	17,279

* Having shipments of less than 10 cars.

METHOD OF CALCULATING TOTAL COSTS OF LOADING ON THE JOINT-ACCOUNT BASIS

The arrangements between many-station dealers and joint-account loaders were not uniform. Minor adjustments had to be made in practically every case. The following example, however, illustrates the general method used in determining the cost to society of loading on the joint-account basis.

For the many-station dealer designated as *A*, the average rate paid for loading on the commission basis was 6.63 cents per bushel. Men who loaded for many-station dealers on the commission basis incurred expenses of approximately 3.01 cents per bushel, which they had to pay out of their commission of 6.63 cents per bushel. The joint-account loader usually had the option of loading on the commission or on the joint-account basis; so it was assumed that the services of the joint-account loader were worth approximatley 6.5 cents per bushel. The total loading expenses per carload at the shipping point incurred by commission and by joint-account loaders were approximately equal. Dealer A's agreements with his joint-account loaders were that they would pay one-half of all costs and get one-half of all profits on the cars so loaded, but the profits were calculated after all costs had been deducted. This was equivalent to saying that although the joint-account loader was charged with only one-half of the costs, the profits in which he shared were calculated after full costs were deducted. To determine the pay for the joint-account loader, the share of the costs of the joint-account loader and the many-station dealer would first have to be deducted from the average commission of 6.63 cents per bushel. For the many-station dealer this 6.63 cents per bushel would have to cover: *a*, the share of the expenses of the joint-account loader which was paid by the many-station dealer; (this would not have been paid for commission loaders); *b*, the share of the expenses of the joint-account loader which was paid by himself; *c*, the joint-account loader's own labor.

The accounting records of the many-station dealer showed the total cost which he paid. Thus, for dealer A, the cost on his books was $5838.22; then, $a + b$ = $11,676.44, or the cost of loading potatoes at the shipping point not including *c*, the cost of the joint-account man's own labor. Approximately 510 carloads, or 306,000 bushels, were loaded for dealer A on the joint-account basis; then $11,676.44 ÷ 306,000 = $0.0382, or 3.82 cents, which was the total cost per bushel of loading on the joint-account basis, not including *c*, the cost of the joint-account man's own labor.

The joint-account man could have received 6.63 cents per bushel if he had loaded on the commission basis instead. The expenses on the joint-account basis, as shown in the preceding paragraph, were 3.82 cents per bushel; then 6.63 cents − 3.82 cents = 2.81 cents, which was the value of the joint-account man's labor per bushel; and 2.81 cents × 306,000 (number of bushels) = $8598.60, the cost for dealer A of the labor of the joint-account loaders. This amount added to $11,676.44 (the sum of *a* and *b* at the station of the joint-account loader) would equal $20,275.04, the total cost for dealer A of loading potatoes on the joint-account basis.

TIME ESTIMATES

The time consumed in the various processes through which potatoes were put at the country shipping points was estimated by 52 loaders for both seasons. The variations in their estimates and the average of all are given in table 90. The estimates given by each shipper were used in calculating the allocations of time for each individual record, but the process costs were determined only as an average of the total.

TABLE 90. Estimate of Hours of Labor Required in Various Processes for Handling a 600-Bushel Carload of Potatoes, 52 Loaders, Seasons 1921–22 and 1922–23

Loader's no.	Process						
	Grading and sacking	Storing	Preparing car	Loading car	Sorting and binning	Grading and loading, bulk	Heating car
1	40	40	1	6	....	....	....
2	40	....	1	6	....	....	....
3	....	....	1	6	40	....	....
4	40	40	1	6	....	....	....
5	60	20	4	18	....	20	3
6	40	40	1	6	....	....	....
7	45	....	6	8	15	....	5
8	45	....	4	6	65	20	1
9	44	....	2	6	....	40	2
10	30	....	10	6	....	40	1
11	60	50	3.5	6	....	50	2
12	40	....	6	6	30	30	2
13	20	....	4	4	40	....	5
14	60	....	29	6	....	....	3
15	30	....	1	6	30	30	1
16	20	....	5	6	20	....	0.5
17	43	....	2	6	30	34	1
18	43	....	2	6	30	34	1
19	48	....	2	6	36	....	2
20	43	....	2.5	6	30	34	2
21	43	....	2.5	6	30	34	2
22	40	....	1	4	20	30	0.5
23	60	....	2	10	60	60	3
24	43	....	1	6	....	30	....
25	43	43	1	6	....	30	....
26	43	....	2	6	....	30	....
27	32	....	0.5	6	32	....	0.5
28	30	....	1	6	....	....	1
29	40	....	10	6	30	30	1
30	24	....	1	10	16	....	1
31	32	....	2	10	....	....	....
32	30	....	1.5	6	20	20	1.5
33	43	....	2.5	6	30	34	1
34	....	....	3	....	20	40	1
35	43	....	2	6	....	30	2
36	24	....	5	6	24	24	1
37	45	....	1	6	30	30	0.5
38	75	....	5	6	35	35	3
39	54	....	4	6	24	30	1
40	24	....	2	6	12	24	2
41	60	....	1	6	....	....	2
42	36	....	2	6	30	30	5
43	45	....	4	6	36	30	2

TABLE 90 (*concluded*)

Loader's no.	Process						
	Grading and sacking	Storing	Preparing car	Loading car	Sorting and binning	Grading and loading, bulk	Heating car
44	30	....	2	6	30	30	2
45	30	....	3	6	30	30	1
46	54	....	3	6	54	36	2
47	36	....	1	6	....	27	1
48	45	....	3	6	30	60	5
49	30	....	0.75	6	24	....	1
50	36	....	2	6	27	27	2
51	45	....	....	6	....	60	....
52	48	....	2	6	30	30	1
Average..	41	38.8	3.1	6.3	30.9	33.4	1.8

ACTUAL PRICES RECEIVED

In tables 91 and 92 are given the actual prices paid to growers and the prices received by dealers and shipping associations during the seasons 1921–22 and 1922–23, respectively.

TABLE 91. COMPARISON OF AVERAGE WEEKLY PRICES AT COUNTRY SHIPPING POINTS, 24 SHIPPING AGENCIES, SEASON 1921–22

Date, week ending	Price per bushel paid to growers				Net wholesale price realized			
	Cooperatives	Single-station dealers	Many-station dealers	Average for all agencies	Cooperatives	Single-station dealers	Many-station dealers	Average for all agencies
Sept. 3	..	.....	$1 33	$1 33	....	....	$1.67	$1.67
Sept. 10	$1 36	.....	1.05	1.08	$1.57	......	1.38	1.40
Sept. 17	1.48	$1 08	1.04	1.09	1.73	$1.15	1.31	1.35
Sept. 24	1.03	0 86	1.02	1.01	1.20	1.03	1.21	1.19
Oct. 1	0.92	0.79	0.99	0.96	1.09	0.92	1.09	1.07
Oct. 8	0 95	0.76	0.92	0.91	1.13	0.87	1.10	1.08
Oct. 15	0.97	0.86	1.01	0.99	1.15	0.98	1.17	1.15
Oct. 22	0.93	0.89	0.98	0.97	1.12	1.01	1.12	1.11
Oct. 29	0 94	0.92	1.01	0.99	1.10	0.99	1.11	1.10
Nov. 5	0.92	0.90	0.96	0.94	1.07	0.97	1.09	1.07
Nov. 12	0.92	0.92	0.96	0.96	1.04	0.97	1.07	1.06
Nov. 19	0.92	0.86	0.95	0.94	1.03	0.99	1.05	1.04
Nov. 26	0.88	0.87	0.93	0.92	1.05	1.01	1 04	1.03
Dec. 3	0.87	0.81	0.91	0.89	0.96	0.91	1.03	1.00
Dec. 10	0.86	0.85	0.89	0.89	1.02	0.95	1.02	1.02
Dec. 17	0.89	0 84	0.90	0.90	1.04	0.99	1.03	1.02
Dec. 24	0.98	0.84	0 86	0.88	1.02	0 97	1.00	1.00
Dec. 31	0.82	0.83	0.90	0.88	0.96	1.07	1 06	1.05
Jan. 7	1.01	0 99	1.02	1.01	1.21	1.13	1.23	1.22
Jan. 14	0.92	1.00	1.01	1.00	1.12	1.17	1.16	1.16
Jan. 21	1.01	1.04	1.02	1.02	1.14	1.24	1.20	1.19
Jan. 28	0.95	1.00	1.03	1.01	1.07	1.16	1.19	1.17
Feb. 4	1.01	1.00	1.03	1.03	1.19	1.10	1.23	1.21
Feb. 11	1.00	1.00	1.03	1.02	1.17	1.08	1.16	1.16
Feb. 18	0.98	0.98	1.03	1.02	1.08	1.20	1.15	1.15
Feb. 25	0.94	0.93	1.00	0.98	1.10	1.08	1.12	1.11
Mar. 4	0.92	0.91	1.00	0.98	1.12	1.05	1.13	1.12
Mar. 11	0.98	0.93	1.00	0.99	1.16	1.05	1.12	1.12
Mar. 18	0.96	0.87	0.98	0.97	1.15	1.01	1.09	1.09
Mar. 25	0.99	0.90	0.95	0.95	1.19	1.03	1.11	1.11
April 1	0.92	0.64	0.94	0.89	1.11	0.96	1.07	1.06

TABLE 91 (*concluded*)

Date, week ending	Net wholesale price realized				Price per bushel paid to growers			
	Coopera-tives	Single-station dealers	Many-station dealers	Average for all agencies	Coopera-tives	Single-station dealers	Many-station dealers	Average for all agencies
April 8	0.93	0.77	0.92	0.91	1.10	0.83	1.05	1.04
April 15	0.84	0.93	0.88	0.87	1.03	1.08	0.97	0.99
April 22	0.69	0.70	0.81	0.77	0.84	0.71	0.87	0.85
April 29	0.66	0.57	0.70	0.69	0.82	0.66	0.87	0.85
May 6	0.74	0.61	0.71	0.71	0.86	0.71	0.97	0.94
May 13	0.73	0.74	0.79	0.77	0.86	0.83	0.94	0.92
May 20	0.65	0.60	0.75	0.72	0.80	0.70	0.80	0.80
May 27	0.73	0.60	0.65	0.66	0.83	1.58	0.84	0.86
June 3	0.63	0.60	0.65	0.64	0.76	1.87	0.79	0.82
June 10	0.67	......	0.57	0.59	0.84	......	0.79	0.80
June 17	0.72	......	0.61	0.66	0.88	......	1.06	0.98
June 24	......	......	0.63	0.63	......	......	0.83	0.83

TABLE 92. COMPARISON OF AVERAGE WEEKLY PRICES AT COUNTRY SHIPPING POINTS, 34 SHIPPING AGENCIES, SEASON 1922–23

Date, week ending	Price per bushel paid to growers				Net wholesale price realized			
	Coopera-tives	Single-station dealers	Many-station dealers	Average for all agencies	Coopera-tives	Single-station dealers	Many-station dealers	Average for all agencies
Sept. 2	......	......	$0.50	$0.50	......	......	$0.68	$0.68
Sept. 9	......	......	0.50	0.50	......	......	0.61	0.61
Sept. 16	$0.45	......	......	0.45	$0.45	......	......	0.45
Sept. 23	0.45	......	0.50	0.47	0.45	......	0.61	0.50
Sept. 30	0.47	......	0.45	0.46	0.63	......	0.66	0.63
Oct. 7	0.41	$0.37	0.42	0.41	0.56	$0.53	0.56	0.56
Oct. 14	0.37	0.38	0.39	0.38	0.53	0.48	0.55	0.54
Oct. 21	0.40	0.41	0.41	0.41	0.57	0.53	0.56	0.56
Oct. 28	0.44	0.42	0.44	0.44	0.62	0.58	0.61	0.61
Nov. 4	0.47	0.49	0.47	0.47	0.62	0.59	0.62	0.61
Nov. 11	0.45	0.50	0.48	0.48	0.59	0.60	0.60	0.60
Nov. 18	0.45	0.48	0.48	0.48	0.61	0.58	0.59	0.59
Nov. 25	0.44	0.47	0.47	0.46	0.59	0.62	0.57	0.57
Dec. 2	0.41	0.50	0.45	0.45	0.57	0.62	0.57	0.57
Dec. 9	0.41	0.43	0.44	0.43	0.57	0.55	0.57	0.57
Dec. 16	0.43	0.44	0.44	0.44	0.61	0.58	0.59	0.59
Dec. 23	0.47	0.46	0.45	0.46	0.64	0.60	0.62	0.62
Dec. 30	0.47	0.45	0.46	0.46	0.64	0.63	0.62	0.63
Jan. 6	0.47	0.46	0.47	0.47	0.63	0.65	0.61	0.61
Jan. 13	0.46	0.43	0.46	0.46	0.61	0.58	0.61	0.61
Jan. 20	0.47	0.43	0.46	0.46	0.63	0.60	0.62	0.62
Jan. 27	0.48	0.44	0.48	0.47	0.65	0.63	0.64	0.64
Feb. 3	0.49	0.46	0.48	0.48	0.66	0.63	0.63	0.63
Feb. 10	0.46	0.45	0.48	0.48	0.64	0.64	0.61	0.62
Feb. 17	0.43	0.45	0.47	0.46	0.60	0.64	0.61	0.61
Feb. 24	0.46	0.43	0.47	0.47	0.65	0.62	0.65	0.65
Mar. 3	0.53	0.44	0.49	0.49	0.77	0.71	0.73	0.73
Mar. 10	0.61	0.48	0.50	0.52	0.81	0.77	0.79	0.79
Mar. 17	0.62	0.55	0.56	0.57	0.83	0.80	0.82	0.82
Mar. 24	0.67	0.63	0.64	0.64	0.88	0.92	0.90	0.90
Mar. 31	0.79	0.80	0.71	0.74	1.01	0.95	0.94	0.95
April 7	0.83	0.79	0.78	0.79	1.03	1.03	0.98	1.00
April 14	0.94	0.88	0.85	0.87	1.16	1.21	1.11	1.14
April 21	1.01	0.99	0.94	0.96	1.16	1.19	1.12	1.14
April 28	1.00	0.96	0.98	0.98	1.02	1.18	0.99	1.03
May 5	0.81	0.80	0.95	0.90	0.98	1.17	1.00	1.05
May 12	0.83	0.85	0.91	0.89	1.03	1.19	0.92	0.97
May 19	0.75	0.82	0.94	0.91	0.92	1.14	0.89	0.93
May 26	0.70	0.80	0.88	0.84	0.90	1.10	0.84	0.89
June 2	0.65	0.90	0.92	0.87	0.83	1.10	0.73	0.77
June 9	0.62	0.83	0.93	0.78	0.76	1.08	0.70	0.85
June 16	0.70	0.62	0.70	0.66	0.91	0.79	0.92	0.85
June 23	0.57	0.62	0.48	0.57	0.76	0.87	0.63	0.79
June 30	......	......	1.02	1.02	......	......	1.02	1.02
July 7	......	0.67	......	0.67	......	0.86	......	0.86

WORKING SCHEDULES

It was found impracticable to use any particular form in the field work, as the detailed information had to be gathered in a variety of ways. When the cost data had been summarized, they were transferred to a work schedule form, shown on the following pages, and the costs were allocated according to the directions given in succeeding paragraphs.

EXPLANATION OF GROUP ITEMS OF COSTS AND RETURNS

Labor and management.— Costs for labor and management include all costs for hired labor, employer's liability insurance paid for such labor, an estimate of the value of the share of the manager's time as an actual laborer, and an estimate of the value of officers' and manager's time in managing labor.

Warehouse costs.— Warehouse costs include depreciation, interest, repairs, taxes, and fire insurance on owned buildings or the rent paid for the use of buildings not owned. Where the ground site of the warehouse was owned by a railroad, the annual rental was included in warehouse costs.

Equipment costs.— The costs for equipment include depreciation, interest, repairs, and fire insurance on potato-handling equipment owned or the rent paid for equipment leased.

General office costs.— General office expenses include the following items: fuel and light for office use; salaries of clerical help; general office supplies; rent of office where the office building was leased, advertising and publicity; market news service; interest on borrowed operating capital; interest on owned operating capital; interest, depreciation, repairs, and insurance on office furniture and fixtures; and an estimate of the value of the manager's or the officers' time as office or sales manager.

Telephone and telegraph.—All expenses incurred in the use of the telephone and the telegraph are included in the group costs for telephone and telegraph.

Bank exchange.—A few of the shipping agencies had no charge for bank exchange. This charge was made by banks for the forwarding and collecting of drafts. On the average, the charge was approximately 0.25 per cent of the face value of the draft.

Brokerage and commissions.— The costs for brokerage and commissions included the following: brokerage fees; charges made by commission merchants for carloads sold on the commission basis; and the pay of joint-account sales agents for selling carloads in terminal markets on the joint-account basis.

Linings.— The expenses for linings include the cost of building paper, straw, and lumber used for lining cars to protect the potatoes against damage.

Sacks, tags, and twine.— Costs for sacks, for twine used in sewing sacks, and for tags attached to sacks, are included under sacks, tags, and twine.

Miscellaneous costs.— The miscellaneous costs are for fuel for heating warehouse and cars; light and power used in handling potatoes; insurance on stock; traveling expenses; bad debts; inspection fees; freight, express, and drayage on supplies; demurrage; miscellaneous supplies; and miscellaneous operating expenses.

DETAILED INSTRUCTIONS FOR WORKING SCHEDULE

Primary Costs

Primary costs nos. 1 to 14, and 17 to 30, inclusive, and also 31 and 33, may be obtained from the accounts of the business. Items nos. 15, 16, and 32 may be obtained from the accounts, or they may have to be computed as shown in the following paragraphs. Item no. 30a also must be computed.

Item no. 15.— To determine the depreciation on a warehouse it is necessary to ascertain the probable life of the building, its cost, and its probable junk value. The difference between the cost and the junk value, divided by the probable life, is the amount which must be charged to depreciation. The usual rate on frame buildings is from 5 to 10 per cent a year.

Item no. 16.— The depreciation on equipment is computed in the same manner as that on a warehouse. The usual rate of depreciation on equipment is from 10 to 20 per cent a year.

Item no. 17.— Officers' salaries include special per-diem payments or traveling expenses paid to officers. Special attention should be given to proprietors' or stockholders'

salaries, and the report should state whether these amounts appear to be fair compensation for services performed.

Item no. 30.— The interest on net worth is ascertained by computing the interest at the rate applicable for the period on accounting capital and surplus. The rate applied is then inserted in the blank.

Item no. 32.— The depreciation on furniture and fixtures is computed as shown for item no. 15. The usual rate of this depreciation is from 5 to 10 per cent a year.

Distribution of Primary Costs to Classification

The following items should ordinarily be allocated to *Distribution to Classification* in the manner indicated:

1. *Labor*, carry to Direct Labor Cost.
2. *Sacks, Tags, and Twine*, carry to Other Direct Cost.
3. *Rent – Warehouse*, carry to Building Cost.
4. *Taxes – Warehouse*, carry to Building Cost.
5. *Personal Property Tax*, carry to Other Direct Cost or to General Office Cost, according to its application.
6. *Insurance – Warehouse*, carry to Building Cost. (Insurance on merchandise should be carried to Other Direct Cost.)
7. *Insurance – Employer's Liability*, divide between Direct Labor Cost and General Office Cost.
8. *Fuel*, divide according to its use. If cars are heated, portions of this charge should be carried to General Office Cost and to Other Direct Cost.
9. *Light*, carry to Light, Power, and Equipment Cost and to General Office Cost, in proportion to its use.
10. *Power*, carry to Light, Power, and Equipment Cost.
11. *Linings*, carry to Other Direct Cost.
12. *Repairs*, carry to Building Cost.
13. *Supplies*, divide between Building Cost and Light, Power, and Equipment Cost.
14. *Miscellaneous Operating Expenses*, carry to Other Direct Cost.
15. *Depreciation – Warehouse*, carry to Building Cost.
16. *Depreciation – Equipment*, carry to Light, Power, and Equipment Cost.
17. *Officers' Salaries*, carry to Management Cost unless labor is performed also. In this case divide between Direct Labor Cost and Management Cost, in proportion to the application.
18. *Manager's Salary*, divide between Direct Labor Cost, Management Cost, and General Office Cost, in proportion to the amount of time given to each.
19. *Office Salaries*, carry to General Office Cost.
20. *Traveling Expense*, if for messengering, carry to Other Direct Cost. Sometimes this should be distributed to Buying and Selling Process Costs.

21 to 26. *Printing and Stationery, Postage, Office Supplies, Telephone (and Telegraph), Licenses and Fees, Office Rent*, carry to General Office Cost.

27. *Brokerage and Commissions*, carry to Other Direct Cost.

28 to 32, except 30a. *Advertising and Publicity, Market Service, Interest on Borrowed Money (used for working capital), Miscellaneous Office Expense*, and *Depreciation on Furniture and Fixtures*, carry to General Office Cost.

30a. *Interest on Net Worth*, divide between Building Cost, Light, Power, and Equipment Cost, and General Office Cost, in proportion to the investment in each. Borrowed money may be for working capital, or it may be for paying for buildings and equipment.

33. *Bad Debts*, carry to Other Direct Cost.

Method of allocating Classification to Distribution to Enterprise, and to Distribution of Potato Costs to Process and Other Factors

Direct Labor Cost.— Allocate direct labor cost to the various branches of the business so as to determine the costs for labor used in handling potatoes; allocate this labor to the Process Costs listed. Both allocations should be made on the basis of the actual amount of labor used. The amount of labor used in each branch and in each process

of the potato business should be made through actual work records, as the daily time sheet shown here; or by "trial runs," using this same sheet; or by means of the labor distribution schedule, obtaining the data by the survey method. The Process Costs are: Buying and selling; receiving and weighing; grading and sacking; storage; sorting and temporary storage; preparing car; loading car, sacked, grading and loading, bulk; messengering.

DAILY TIME SHEET

Name of company .... Shipping point ....

Manager .... Date ....

Distribution of work done

Name of worker	Potatoes									Other work			
	Buying and selling	Weighing and receiving	Grading and sacking	Loading car, sacked	Preparing car	Storage	Sorting and temporary storage	Grading and loading, bulk	Messengering	Cabbage	Feed	Coal	

Building Cost.— Allocate the building cost to the various branches of the business on the basis of the value of the space used by each branch and its relative importance in the business. On the same basis, distribute the building cost charged to potatoes to the various process costs.

Light, Power, and Equipment Cost.— Allocate light, power, and equipment cost to the various branches of the business and to the Process Costs, on the basis of the value of the light, power, and equipment used for each.

General Office Cost.— Allocate general office costs to the various branches of the business, on the basis of the office requirements of each department and its relative importance in the business. The general office expense allocated to potatoes should be charged to Buying and Selling Process Costs.

Management Cost.— Allocate management cost to the various branches of the business and to the Process Costs, on the basis of the direct labor charged to each and its relative importance in the business.

Allocate the amount of management charged to the potato business to the various items under Process Costs on the basis of the direct labor charged to each.

Other Direct Cost.— Allocate other direct cost to the various branches of the business, in proportion as they apply as follows:

2. *Sacks, Tags, and Twine*, carry to Sacks, Tags, and Twine.
5. *Personal Property Tax*, carry to Storage.
11. *Linings*, carry to Preparing Car.
20. *Traveling Expense*, divide between Buying, Messengering, and Selling, in proportion to use.
27. *Brokerage and Commissions*,[19] carry to Brokerage and Commissions. Separate the buying and the selling commission if possible.
33. *Bad Debts*, carry to Bad Debts.

Storage. Storage costs are intended to cover only potatoes that are actually stored, and the costs incident to storing.

Sorting.— Costs for the reconditioning of potatoes stored temporarily should be included under *Sorting.*

Labor Distribution

On the first line, enter the amount paid for labor, as shown on the Working Schedule.

On the second line, enter the percentages of time used by labor in potato operations.

On the fourth line, enter the average cost per man hour paid for labor in potato operations.

On the fifth line, enter the number and the kinds of units — pounds, sacks, barrels, of potatoes purchased.

On the sixth line, enter the number and the kinds of units of potatoes sold.

Number of Men.— In the first column enter the average number of men engaged in each of the several processes.

Number of Units.— In the second column enter opposite each item the number, only, of units in the process.

Kind of Units.— In the third column enter the kind of unit used.

Rate of Work.— In the fourth column enter the average number of units handled by one man in an hour.

Total Man Hours.— In the last column enter the number of man hours, ascertained by dividing the number of units by the rate of work.

Cost of Potatoes Sold

Opposite *Purchases* (*Paid to Growers, Cooperatives*), enter the total amount paid for potatoes; or, in a cooperative enterprise, the total amount paid to the growers for the potatoes sold. To this amount add the value of any inventory of potatoes on hand at the beginning of the period being studied. From the total of these two items deduct the value of any inventory of potatoes on hand at the end of the period. To this remainder add any buying commission paid by the enterprise during the period. The resulting total is the cost of potatoes sold, and should be carried to the working schedule as item 58. If a buying commission is shown here, it should not be included in either item 27 or item 54 on the Working Schedule, and a note to this effect should be entered on line 54 opposite *Buying.*

Analysis of Branch House Expense Paid by Home Office

Where the business being studied is a branch of a larger organization, care should be taken to ascertain whether any of the costs applicable to the branch are borne by the home office. If so, any such costs should be entered in this schedule. Amounts borne by the home office must be included in the Primary Costs shown on the Working Schedule.

Home Office Overhead

Where the operation being studied is a branch operation, the total overhead expense of the home office must be ascertained and entered on this schedule. On the line *Pro-Rata Share to this Branch*, enter the share of the total of the preceding items that should be rightfully borne by the branch. This amount should be transferred to line 38 of the Working Schedule, and distributed to General Office Cost and Management Cost, and to Buying and Selling Process Costs. A study of this schedule will assist in the proper allocation on the Working Schedule.

[19] This item is so carried in order to maintain its integrity. In the accounts it should be distributed to Buying and Selling, in proportion to its application.

General Survey of Local Marketing Organization

The general survey schedule is, for the most part, self-explanatory. The following items may need additional explanation.

Type of Company should indicate whether it is a firm, a corporation, a cooperative, or a branch of a larger organization, and should give some information as regards the parent company.

Methods of Selling Potatoes should show whether the potatoes are sold through brokers, through commission companies, or direct to the wholesaler or the jobber, and the percentages sold through the several channels should be indicated. This item should state also whether the potatoes were sold in bulk or in containers, the kind and size of the containers, and the percentage sold each way.

Analysis of Bad Debts should specify such debts as occurred during the period being studied, arising from the several sources shown on the schedule. Under *Amount Arising from Sales*, enter only those amounts which resulted from nonpayment or from partial nonpayment for potatoes sold. Under *Amount Uncollectable from Joint-Account Operations*, enter only such amounts as represent advances to joint-account operators or the proportions of trading losses which are uncollectable. Under *Amount Uncollectable from R. R. Claims and Other Claims*, enter such amounts as represent claims for losses of potatoes, of linings, and so forth, that occurred in transit.

Branch Manager's Salary — Commission or Profit

It will sometimes be found that managers of branch organizations receive a salary or a commission, or may share in the trading profits, out of which compensation they, the branch managers, pay certain of the operating expenses. On the first line in this schedule, enter the balance netted by the manager after he has paid such expenses. On the second line, enter the amount of the salary which you estimate to be a fair compensation for services rendered by the manager and for his abilities in potato marketing, if all expense of the operation had been paid by the home office.

The costs entered on this schedule must be transferred to and included in similar costs on the Working Schedule.

It frequently happens in organizations of this kind that the manager furnishes the warehouse and the equipment. A section is therefore provided in this schedule for these data.

Monthly Balances — Accounts and Notes Payable

In the schedule of monthly balances, enter opposite the month the balances shown in accounts and notes as they appear on the last day of each month. Enter the balance for only the months covered by the study.

Analysis of Deductions for Losses

Enter in this schedule the losses suffered by way of allowances or due to the resale of rejected cars. The certificate of inspection on which all such allowances were claimed or on which rejections were made, should be examined and the cause ascertained. The amount of loss or the allowance made, should be entered opposite the kind of car used and in the column designating the cause of the loss.

Whenever possible, copies of the balance sheets prepared by the company should be obtained, one dated to correspond with the beginning and one with the termination of the period studied. Enclose these sheets with your report. Enter the percentage of each item that should be allocated to potato operation. Care must be used in determining these allocations, and every source of information should be studied in order to make them as nearly accurate as possible.

Where no balance sheets have been prepared by the company, the items should be compiled from the accounts, if possible, or an inventory should be made of the assets, together with their cost and the dates of purchase. The amount of liabilities should also be ascertained.

WORKING SCHEDULE

Report by Cooperative — Country Buyer — Wholesaler — Jobber or Commission Dealer

Name of Company..........

Primary Costs				Distribution to Classification						
	Item	Per cent to potatoes	Total amount	Direct labor cost	Building cost	Light, power, and equipment cost	General office cost	Manage-ment cost	Other direct cost	Explanatory
1	Labor									
2	Sacks, Tags, and Twine (Net)									
3	Rent — Warehouse									
4	Taxes — Warehouse									
5	Personal Property Tax									
6	Insurance — Warehouse									
7	Insurance — Employer's Liability									
8	Fuel									
9	Light									
10	Power									
11	Linings (Net)									
12	Repairs									
13	Supplies									
14	Miscellaneous Operating Expenses									
15	Depreciation — Warehouse									
16	Depreciation — Equipment									
17	Officers' Salaries									
18	Manager's Salary									
19	Office Salaries									
20	Traveling Expense									
21	Printing and Stationery									
22	Postage									
23	Office Supplies									
24	Telephone									
25	Licenses and Fees									
26	Office Rent									
27	Brokerage and Commissions									
28	Advertising and Publicity*									
29	Market Service									
30	Interest on Borrowed Money									
30a	Interest on Net Worth @ ....%									
31	Miscellaneous Office Expense									
32	Depreciation, Furniture and Fixtures									
33	Bad Debts									
34										
35										
36										
37										
38	Home Office Overhead (Pro-Rata Share)									
	Total									

* Advertising and publicity should include donations.

	Item	Distribution to Enterprise	Total units handled	Unit per cwt.	
39	Feed				
40	Other Produce				
41	Potatoes				
	Total				

	Item	Distribution of Potato Costs to Process and Other Factors	Units in Process: Lbs., sacks, or bbls.	Units in Process: Cars	Cost per unit loaded	
42	Buying and Selling					
43	Receiving and Weighing					
44	Grading and Sacking					
45	Storage					
46	Sorting and temporary Storage					
47	Sacks, Tags, and Twine					
48	Preparing Car					
49	Loading Car, Sacked					
50	Messengering					
51	Other Transportation (Not including freight					
52	Grading and Loading, Bulk					
53	Inspection					
54	Brokerage and Commissions { Buying / Selling					
55	Bad Debts					
56	Other Costs					
57	Total					

	Item	Other Accounting Factors
57	Total Costs — Potatoes	
58	Plus Cost of Potatoes Sold	
59	Total	
60	Sales	
61	Less Returned Sales	
62	Less Allowances Deducted for Loss	
63	Less Freight	
64	Net Sales	
65	Net Profits	

Labor Distribution

Total cost of labor for year............ $..........

Per cent of total labor cost used on potatoes.......%..........

Estimated weighted average cost per hour of labor on potatoes.......... $..........

Number of units of potatoes bought..........

Number of units of potatoes sold..........

	No. of men	No of units	Kind of units	Rate of work	Total man hrs.
Weighing and receiving					
Grading and Sacking					
Loading Car					
Preparing Car					
Storage					
Sorting					
Buying					
Selling					
Messengering					
Total man hrs.					

Equipment Data

Item	Cost value			Market value		
Scales						
Dumping Equip't						
Elevator Equip't						
Grading Equip't.						
Power Equip't						
Other Equip't.						
Remarks:						

Cost of Potatoes Sold

Purchases (Paid to Growers, Cooperatives)									
plus, Inventory Beginning									
less, Inventory Ending									
plus, Buying Commission									
Cost of Potatoes Sold									

Analysis of Branch House Expense Paid by Home Office

1	Labor			
2	Sacks, Tags, and Twine			
3	Rent–Warehouse			
4	Taxes			
5	Personal Property Tax			
6	Insurance–Warehouse			
7	Insurance–Employer's Liability			
8	Fuel			
9	Light			
10	Power			
11	Linings			
12	Repairs			
13	Supplies			
14	Miscellaneous, Operating Expense			
15	Depreciation–Warehouse			
16	Depreciation–Equipment			
19	Branch Office Salaries			
23	Branch Office Supplies			
26	Office Rent			
31	Miscellaneous–Branch Office Expense			
32	Depreciation, Furniture and Fixtures, Branch Office			

Home Office Overhead

Officers' Salaries			
Manager's Salary			
Office Salaries			
Traveling Expense			
Printing and Stationery			
Postage			
Office Supplies			
Telephone and Telegraph			
Licenses and Fees			
Office Rent			
Brokerage and Commissions			
Advertising and Publicity (including Donations)			
Market Service			
Interest on Borrowed Money			
Interest on Net Worth			
Miscellaneous Office Expense			
Depreciation, Furniture and Fixtures			
Bad Debts			
Total			
* Pro-rata share to this branch.			

* Transfer to Working Schedule, Item 38

General Survey of Local Marketing Organization

Type of Company..

Location of Shipping Point... R.R ....

Central Office..

Principal Kinds of Business ....

Importance of Potato Business in General Business ....

When was Company Organized ....

Volume of Business Last Year $............................... No. of Units ....

....

Warehouse

Size..Construction ....

Stories.................................... Winter Storage Space for Potatoes.........................

Proportion of Space used by Potatoes...

Market Value of Warehouse..

Replacement Cost of Warehouse..

Cost of Warehouse ....

Amount of Insurance Policies on Warehouse ....

Amount of Land Used.................................Rented or Owned ....

Location of R. R. Switch..

Amount of Switching Space ....

Number of Loading Doors in Warehouse ....

Total Value of Real Estate Owned or Rented..

Explain Depreciation Allowed on Working Schedule. ....

Other Assets

Channels Through which Product is Usually Sold

Methods of selling potatoes ....

Per cent through each method..

Advantages of the various methods..

....

....

Analysis of Bad Debts

Amount arising from Sales ....

Amount uncollectable from Joint-Account Operations ....

Amount uncollectable from R R. Claims and Other Claims..

Remarks ....

Branch Manager's Salary–Commission or Profit

Balance over expense paid by him. ....

Estimated value of his services had Home Office paid all expense and provided the Warehouse and Equipment ....

Monthly Balances–Accounts and Notes Payable

Month	Accounts payable	Notes payable	Month	Accounts payable	Notes payable
August			April		
September			May		
October			June		
November			July		
December			August		
January			September		
February			October		
March			November		
			December		

Analysis of Deductions for Losses

	Amount of Loss on Refrigerator Cars	Amount of Loss on Lined Cars	Amount of Loss on Cars Option 1	Amount of Loss on Cars Option 2	Amount of Loss on Cars Option 3	Amount of Loss on Other Unlined Cars
No. of cars used						
No. of trips						
Under size						
Old frost						
Scab						
Dry rot						
Sweat						
Frost						
Blemish						
Wet rot						
Shortage						
Other causes						

Bulletin 441 August, 1925

Economic Studies of Dairy Farming in New York. IV

Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1921

E. G. Misner
In cooperation with the Bureau of Agricultural Economics of the United States Department of Agriculture

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CONTENTS

ECONOMIC STUDIES OF DAIRY FARMING IN NEW YORK. IV. GRADE B MILK WITH CASH CROPS AND MIXED HAY ROUGHAGE, CROP YEAR 1921

E. G. Misner [1]

In the summer of 1922, the United States Department of Agriculture and Cornell University began a study of the organization and the dairy-enterprise costs on different types of dairy farms in New York. This bulletin is the fourth of a series reporting the results of the investigation,[2] and is concerned with the results for 121 farms in northern Chenango and southern Madison Counties for the year ending April 30, 1922. The system of farming combines the production of Grade B milk for shipping stations, with cultivated cash crops such as potatoes, cabbage, market peas, and hops.

REGIONAL CONDITIONS

The farms are located in the Chenango Valley from Bouckville to North Norwich, and on the uplands a short distance both eastward and westward from this valley. Earlville is approximately in the center of the area and has about 890 inhabitants, the greater number of whom are retired farmers. The main east-and-west street is the Chenango-Madison County line. The post office is in Madison and the bank in Chenango County. The principal industries of the village are the Earlville Paper Box Co., making chiefly the boxes for the Oneida Community

[1] The writer was assisted in the field the first year by I. J. Call, M. J. B. Ezekiel, W. C. Funk, J. F. Harriott, Bruce McKinley, and J. J. Vernon. The work has been continued on the same farms for the 1922, 1923, and 1924 crop years. The information was gathered thru a cooperative agreement between the Department of Agricultural Economics and Farm Management of the New York State College of Agriculture at Cornell University, Ithaca, New York, and the Divisions of Farm Management and Cost of Production, Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C.

The following farmers cooperated by furnishing information for the crop year of 1921:

Operators: L. A Abbott, Frank Adams, George A Adams, George Armstrong, L. W. Armstrong, H. S. Baker and son, Wesley Barber, Barnes and Grotsinger, Warren Barnes, Clayton Bartlett, M. H. Bartlett, Fred A. Beecher, E N. Bensley, W. L. Bierce, T. W. Billings, C. H. Boos, M. J. Briggs, Ezra Briman, Leon H. Brown, H. Button, Burt Butts, Frank H. Chrisman, W. G. Clark, Close and Hall, Coleman Bros., H. R. Cook, C. J. Coy, H. C. Craver, C. R. Crumb, I. Davidson, J C. Denney, Lewis H. Dennis, Dungey and Humphrey, Fred A. Eccleston, Eddy and Burke, F. H. Eddy, Will Fairchild, J. J. Farley, M. W. Farley and son, D. N. Felt, S. A. Fisher, Fred Follett, Whitman A. Follett, C. L. Frick, J. E. Gaines, P. J. Gilmartin, E. Gorton, B. R. Greene, H. D. Groves, F. F. Guthrie, Leo Hafelin, Harrington sisters, Henry Bros., Clark Holmes, C. J. Hoose, John Howard, Ira Ingraham, Chas. Izard, C. H. Jantzen, W. P. Jeffrey, E. H. Jenne, Earl Jones, LaFayette W. Knapp, H. N. Kutschbach, A. E. Lamb, John W. Lamb, Henry Lathrop and sons, P. J. Lawrence, W. E. Lorimer, Mrs. Carrie E. Lyons, Jay B, Marshall, Mrs. McMulligan, C. C. Merrill, G. E. Moran, Clarence Oakes, J. M. Olson, L. W. Paddleford. C. L. Puffett, Leslie Reese, E. B. Reynolds, F. Rhoades, O. C. Roach, E. C. Rose, Arthur T. Ryan, A. C, Sabin, I. U. Scott, H. N. Sexton, W. A. Shapley, L J Slentz, Edwin P. Smith, F. J. Snell, E. J. Snitchler, E. H. Spicer, A. Squires, F. H. Stapleton, C. B. Stowell, George R. Sundell, A. P. Svenson, M. W. Symonds, K. C. Thornton, Fred Tiffany, F. M. Tiffany, E. S. Tillapaugh, W. D. Usher, Frank A. Van Housen, B. J. Van Wagner, R. H. Volmer, D. Ward, Ira T. Walker, Fred J. Welch, Floyd Wells, G. D. Whitford, Louis L. Wilbur, C. G. Wilcox, H. H. Wilcox, M. L. Wilcox, S. R. Wilcox, G. W. Wood, Stephen S. Woodman, George Wooster, Thos. E. Wratten.

Landlords: Adelbert Abbott, Barrows and Brown, Mrs. B. Bowers, Mrs. Bressee, C. J. Coleman, W. C. Crouch, Mrs. A. Davis, A. A. Hartshorn, W. H. Hartwell, Mrs. Kinney, O. S. Langworthy, C. H. Lathrop, W. J. Morse, C. B. Newman, Will Perry, W. F. Plumb, Alfred Reese, N. F. S. Russell, J. S. Sears, F. L. Stebbins, D. J. Sweeney, A. M. Tefft, G. A. Tiffany, William L. Titus.

[2] The preceding bulletins in this series are:

Economic studies of dairy farming in New York. I. Condensery milk without cash crops. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bulletin 421. 1923.

Economic studies of dairy farming in New York. II. Grade A milk with and without cash crops. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bulletin 433. 1924.

Economic studies of dairy farming in New York. III. Grade B milk with alfalfa roughage. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bulletin 438. 1925.

Limited; the Chandler, Baker & Millard Co., manufacturing concrete tile and fence posts; the Cornell Table Works, making dining and school furniture; the Myers & Son wagon works, building Low-Down Milk and Bakery delivery wagons. These industries employ about 200 persons. Three other industries, a furniture factory, two perfumery and extract plants, and a road-drag concern, formerly did business but have discontinued or moved elsewhere. Formerly some dry-goods stores were prosperous, but with present means of transportation the large cities are getting more of the business. The crossroad store is disappearing and this trade goes to the small villages.

A few years ago hop growing was a large and profitable enterprise in the area from Sherburne north thru Earlville, Hamilton, and Bouckville. The majority of the houses are very large, due to the necessity for housing the hop pickers, and most of them are exceptionally well built. The costly construction offers some indication of the apparent prosperity of the business at that time. Years ago the hop-growing industry began to decline, and it remained on only the better farms until the coming of prohibition. On one farm, it is reported, there were nine hop kilns. Only two of these remain and these are soon to be torn down.

The soils of the farms studied were mostly Lordstown, Ontario gravelly silt loam, Lordstown silt loam, Wooster silt loam, Fox gravelly loam, and Chenango gravelly silt loam. The average elevation of the farms was 1181 feet. Of the total number, 35 were hill farms and 86 were valley farms.

The climate at Sherburne, Chenango County, in the southern extremity of the area, was as shown in table 1:

TABLE 1. CLIMATE AT SHERBURNE, CHENANGO COUNTY, IN 1921

Month	Precipitation, in inches		Per cent of normal precipitation in 1921–22
	Normal	1921–22	
May	3.34	2.68	80
June	3.54	2.97	84
July	4.12	3.91	95
August	3.57	3.54	99
September	3.73	3.92	105
October	3.14	4.30	137
November	2.44	5.61	230
December	2.58	1.22	47
January	2.47	1.95	79
February	2.71	2.76	102
March	3.04	6.19	204
April	2.82	4.08	145
Twelve months	37.50	43.13	115

The spring rainfall in 1921 was decidedly below normal, which resulted in reduced yields of hay. The entire growing season was dry, with a temperature above normal, and so there were good yields of corn for the silo. Yields of peas and cabbage, especially on the valley soils, also were good.

When the five-years average for the years 1910 to 1914 is taken as 100, the index numbers of wholesale prices in New York State averaged 144 for the twelve months covered by this study. Milk prices paid to producers at Utica, New York, averaged 141, and the weighted average of prices paid to New York producers for their products was 141.[3]

AGE, TENURE, AND WAGES

Of the 121 farm operators, 47 had attended high school for an average of 2.5 years, 5 had attended business school for 1.2 years, and 8 had attended college for 3.6 years. The average age of the farmers was 43 years.

Of the total, 94 owned, 18 share-rented, and 5 cash-rented all of the land they farmed. There were 4 who owned part of the land they farmed, and of these 1 cash-rented, 2 share-rented, and 1 both cash- and share-rented additional land. Some land was rented out by 3 operators.

The employment history of the present operators is shown in table 2. Of the 97 operators, 48, or about 50 per cent, never had been tenants. The other half came into possession of their property thru the hired-man-tenant method. Of the total farmers, 20 had never worked as hired men on farms but had been employed in other occupations.

TABLE 2. EMPLOYMENT HISTORY OF 121 FARM OPERATORS

	Owner of present farm but never owner of other farms*	Owner of other farms before becoming or while owner of present farm	Share tenants	Cash tenants
Total number of this tenure status	74	23	18	5
Number that never had been tenants	32	16	....	....
Number that had been tenants on present farm but never on other farms	16	1	11	2
Number that had been tenants on other farms but never on present farm	22	6	....	....
Number that had been tenants both on other farms and on present farm	4	0	7	3
Total number that had worked as hired men on farms	52	16	13	4
Number that had worked as hired men on home farm but not on other farms	24	5	4	1
Number that had worked as hired men on other farms but not on home farm	19	8	6	2
Number that had worked as hired men both on other farms and on home farm	9	3	3	1

[3] Prices of farm products in New York. By G. F. Warren. Cornell Univ. Agr. Exp. Sta., Bul. 416, 1923, p. 61.

TABLE 2 (*concluded*)

	Owner of present farm but never owner of other farms *	Owner of other farms before becoming or while owner of present farm	Share tenants	Cash tenants
never worked as rms but had been ɜr occupations...	13	4	2	1
d neither worked ɔn farms nor had in other occupa-	9	3	3	0
d worked as hired ɩs and had been er occupations...	20	8	6	2
d worked as hired ɔut had never been ɩer occupations ...	32	8	7	2

nd for one farm.

e age at which the owners began their present status was the average age at which the tenants began tenancy was .e 3).

E 3. PRECEDING TENURE STATUS OF PRESENT OPERATORS

	Owners*	Share tenants	Cash tenants	All operators
ns.............	97	18	5	120
operator (years). .	45	36	37	43
t which operator began s (years)......	35	... ..	....	....
in present status	9.8	....	....	.. ..
ɜent farm:				
ɜrmers............. ...	21	18	5	44
e when farmer began ɾears)........ .	28	31	30	30
rs in such status	7.4	5.2	7.8	6.5
er farms:				
armers......	32	7	3	42
,e when farmer began ɾears)................	26	29	26	26
ɩrs in such status........	7.8	3.7	4.7	6.9
home:				
;armers............ ...	41	7	2	50
ɜ when farmer began as ɩ (years).......	18	19	15	18
ɩrs in such status...... .	7.0	5.9	4.5	6.7

TABLE 5. LABOR ON 121 FARMS

TABLE 3 (*concluded*)

	Owners*	Share tenants	Cash tenants	All operators
Hired man away from home.				
Number of farmers	39	9	3	51
Average age when farmer began as hired man (years)	19	17	18	19
Average years in such status	7 2	11.1	6 0	7.8
Other occupations:				
Number of farmers	45	8	3	56
Average age when farmer began such occupation (years)	21	24	21	21
Average years in such status	10 2	6 5	6.7	9.5

* One farm is excluded.

The average value placed by the farm operator on his time for twelve months was $1012, which included board but not privileges. The average time spent by the 121 operators was 11.5 months per farm, with an average value of $977. This is $84.77 a month.

The variation in the estimate by farmers of the value of their own time is given in table 4:

TABLE 4. VARIATIONS IN ESTIMATES PLACED BY 121 FARM OPERATORS ON THE VALUE OF THEIR TIME FOR TWELVE MONTHS

Value of operator's labor	Number of farms	Per cent
$ 360	2	1.7
480	1	0 8
600	7	5.8
624	1	0 8
680	1	0.8
720	9	7.4
780	2	1.7
794	1	0.8
810	1	0.8
840	2	1.7
900	37	30.6
954	1	0 8
960	3	2.5
1,000	15	12.4
1,020	1	0.8
1,100	1	0.8
1,200	21	17 4
1,500	9	7.4
1,800	2	1.7
1,825	1	0 8
2,000	3	2.5
Total	121	100 0

The man equivalent, or the average number of persons equivalent to men, computed on a yearly basis of the amount of work, was 2.33 per farm (table 5). Of the total months of labor, 42.9 per cent was time

TABLE 5. LABOR ON 121 FARMS

	Number of farms using	Months worked			Value of unpaid labor		Total wages		Average per month worked	
		Total	Per cent	Per farm	Total	Average per month	Cash	Board	Cash	Value of board
Operator's wife:										
Unpaid	70	198 4	10 3	2.8	$ 9,420	$ 47 48	...	...	...	...
Operator's sons:										
Paid	8	97 5	5 0	12.2	...	...	$ 3,465	$ 1,251*	$35 54	$15.64
Unpaid	29	227	11.7	7.8	11,641	51.28	...	...	...	...
Operator's daughters:										
Paid	2	6.5	0.3	3 2	...	...	484	111	74 46	17 08
Unpaid	4	11	0.6	2.8	402	36.55	...	...	...	...
Operator's other relatives:										
Paid	3	36	1.9	12.0	...	...	1,500	408	41 67	11.33
Unpaid	15	136	7.0	9 1	8,092	59 50	...	...	...	...
Second operator	2	24	1.2	12 0	1,824	76.00	...	...	...	...
Landlord	2	11	0.6	5.5	1,260	114 54	...	...	...	...
Hired men, without board	22	292 5	15.1	13 3	...	...	18,665	...	63 81	...
Hired men, with board	68	744.8	38.5	11.0	...	...	32,111	12,992	43 11	17.44
Hired men, board only	1	5	0.3	5 0	...	...	...	125		25.00
Hired men by day:										
Without board	44	92.8	4.8	2 1	...	...	6,514	...	70 19	...
With board	35	40.6	2.1	1.2	...	...	2,594	642	63 89	15.81
Other help, paid	1	12	0.6	12 0	...	...	240	360	20 00	30 00
Total labor, except operator	121	1,935.1	100.0	16.0	$32,639	$53.74	$65,573	$15,889	$49.58	$17.18
Operator	121	1,395	...	11.5	$118,257	$84.77	...	...	...	...
Son's share as operator	1	8	...	8.0	560	70.00	...	...	...	...
Landlord's share as operator	1	3	...	3 0	180	60 00	...	...	...	...
Hired man's share as operator	6	46	...	7.7	3,410	74.13	...	...	...	...
Total for 12 months time, operator	121	1,452	...	12.0	$122,407	$84 30	...	...	...	...
Man equivalent	...	...	...	2.33	...	...	...	...		...

* Board was furnished for 80 months on 6 farms.

spent by the operator, 21 per cent that spent by other members of the operator's family, and the remaining 36.1 per cent that spent by other persons.

The average monthly wage paid to hired men without board was $63.81, and that paid to hired men with board was $43.11 (table 5). The value of board furnished, excluding the part furnished by the farm, was $17.44 per month.

FARM CAPITAL

The average size of the 121 farms was 167.2 acres, with 63.5 acres, or 38 per cent of the total, in crops. An average of 71.1 acres per farm was in permanent pasture, of which 31.5 acres were considered by the farmers to be tillable. (Table 6.)

TABLE 6. AVERAGE SIZE OF 121 FARMS

	Average acres per farm	Per cent of total acres
Crop land	63.5	38.0
Woods pastured*	14.4	8.6
Rotated pasture	1.0	0.6
Permanent pasture tillable	31.5	18 8
Other permanent pasture	39 6	23 7
Woods not pastured	9.4	5.6
Farmstead, roads, and so forth	7 8	4.7
Total	167.2	100.0

* Equivalent to 2.4 acres of open pasture.

The capital per farm was $16,586, of which 66.7 per cent was in real estate, 24.9 per cent was in livestock, and the remainder was in machinery and supplies (table 7).

TABLE 7. AVERAGE CAPITAL FOR 121 FARMS

	Value per farm	Per cent of total
Real estate	$11,059	66 7
Livestock	4,126	24 9
Machinery	1,232	7.4
Feed and supplies	169	1.0
Total	$16,586	100.0

Of the total capital, 47.6 per cent was represented by the farm buildings, 17.2 per cent was in the dwelling, 19.4 per cent was in the main cattle barns, and 11 per cent was in other buildings. The remaining 52.4 per cent of the total capital was in land; 31.4 per cent was in crop

land, and 15.9 per cent was in pasture land not including the woods pastured. The average values per acre of land were: crop land, $55.04; pasture land, $24.56; and woodland, $18.53. The distribution of the value of the farm real-estate on April 30, 1922, was as shown in table 8:

TABLE 8. DISTRIBUTION OF FARM REAL-ESTATE CAPITAL

	Value per farm	Per cent of total
Dwelling no. 1	$1,914	17.2
Dwelling no. 2 (34 farms)	268	2.4
Dwelling no. 3 (2 farms)	12	0.1
Cattle barn	2,154	19.4
Barn no. 2 (57 farms)	355	3.2
Other buildings	589	5.3
Total buildings	$5,292	47.6
Orchard	$ 55	0.5
Crop land	3,498	31.4
Pasture land, except woods pastured	1,770	15.9
Woodland	441	4.0
Other land	70	0.6
Total land	$5,834	52.4
Total value of farm (land and buildings)	$11,126	100.0

FARM RECEIPTS

Of the total receipts on these farms, 50.6 per cent was cash for milk sold, 3.3 per cent was in certificates of indebtedness of the Dairymen's League Cooperative Association, Inc., 13 per cent was from livestock sold, and 20.5 per cent was from crops sold (table 9). The remaining 12.6 per cent was from increase in inventory and from miscellaneous sources shown in detail later. In addition to the income from milk and cattle sold, there is a considerable income from crops sold, averaging $1043 per farm. The total receipts were $5082 per farm.

TABLE 9. AVERAGE RECEIPTS PER FARM

	Average per farm	Per cent of total
Crops sold	$1,043	20.5
Livestock sold	658	13.0
Milk sold	2,574	50.6
Certificates of indebtedness	166	3.3
Increase in inventory	361	7.1
Miscellaneous	280	5.5
Total	$5,082	100.0

CROPS

The crops grown, the total yields, and the receipts from crops sold, are shown in table 10:

TABLE 10. Crops Raised on 121 Farms

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Corn for grain	112.5	5,985	Bushels	3	$ 7	...	..
Stover from corn for grain		267.3	Tons	4	11	..	..
Corn for the silo	972 3	13,035	Tons....	2	5	.	
Corn for the silo, surplus *	3	.	..	...	8	.	$ 7
	33 7	312	Tons	106	145	.	
Grain from corn for the silo		1,044	Bushels	...	...	..	...
Sweet corn, green	2	20	Tons	....	....	...	.
Other corn fed green	(2)†	17	Tons	....	.....	....	....
	23 5	253	Tons	25	20	....	...
Oats	854 5	26,274	Bushels	584	302	...	...
Oats from share-rented land		200	Bushels	....	....	....	..
Oat straw		659	Tons	28	222	1	7
Oats and barley	115 5	4,600	Bushels	....	..	...	....
Oat and barley straw	.	49	Tons	....	.....	..	..
Barley	105	2,894	Bushels	89	115	..	....
Barley straw	..	61	Tons	...	...	..	...
Buckwheat	47	1,230	Bushels	490	505	233	180
Buckwheat straw	...	28	Tons	....	....	.....	..
Rye	6	180	Bushels	72	86	...	.
Rye straw		8	Tons	....	....		
Winter wheat	126 5	3,038	Bushels	1,756	2,151	238	281
Spring wheat	3 7	60	Bushels	....	.....	.....	.
Wheat straw	.....	90.2	Tons	4.8	29	.....	
Oats, barley, and buckwheat	7	170	Bushels	....	....	....	.
Sudan grass seed	0.5	9	Bushels	4.5	20	4.5	20
Oat, pea, and barley straw	....	12.5	Tons	...	.....	...	..
Oat, barley, and wheat straw	....	12	Tons....	....	......	...	.
Oat and wheat straw	....	10	Tons	...	......	...	.
Oats for hay	145	179	Tons....	12	180	..	.
Barley for hay	5	6	Tons	...	....	..	...
Oats and peas for hay	40	60	Tons	...	.....	..	...
Millet for hay	(0 5)†	1	Tons	....	.....	...	..
	5	6 5	Tons	....	...	....	....
Oats fed green	8	17 5	Tons	....	...	..	.
Oats and peas fed green	10	61	Tons	...	..	....	..
Oats and peas for the silo	6	34	Tons	..	..	..	...
Buckwheat fed green	11	69.5	Tons	...	...	.	.
Oats and buckwheat fed green	3	19	Tons	....	...	.	..
Corn and millet fed green	1	5	Tons....	.....	....	..	.
Oats and millet fed green	2	5	Tons	.....	....	..	..
Millet and sudan grass fed green	1	5	Tons	....	.....		....
Oats and sudan grass fed green	1	10	Tons	...	....	.	.....
Millet fed green	5	43	Tons	....	.....	.	...
Alfalfa fed green, first cutting†	(11)	20	Tons	..	...	..	.
Alfalfa fed green, second cutting†	(5)	17	Tons	..	...		.
Mixed hay fed green†	(7)	4	Tons	.....	....		..
Rowen fed green †	(16)	27.5	Tons	.....	...	.	..
Sudan grass fed green	2 5	20	Tons	....	.....	..	.
Alfalfa (new seeding)	4	..	Tons	..	..	..	...
Alfalfa, first cutting	116	214.5	Tons	12 5	184	3.5	40
Alfalfa, second cutting †	(86 5)	102 5	Tons	2	29	2	29
Alfalfa, third cutting †	(20)	18	Tons	..	..	...	
Mixed hay (clover)	876	1,674	Tons	0 8	10	4	60
Mixed hay (other)	2,447	2,984	Tons	158.5	2,606	11.5	185
Mixed hay (other), share from land rented out		10	Tons	..	..	...	..
Timothy	965	1,585	Tons	114	1,865	17	262
Rowen†	(224)	228	Tons	6	90	..	...
Sudan grass	4	9	Tons	....	...	..	...
Potatoes, share from land rented out	.	40	Bushels	40	40	....	....
Potatoes	156 6	20,639	Bushels	9,642	9,510	1,028	1,061
Cabbage, share from land rented out	.	16	Tons....	16	387	...	..
Cabbage	200 8	2,171	Tons	1,914	53,875	219	5,963
Cabbage refuse	....	532 2	Tons	.	....	.....	....
Market peas	138	20,101	Bushels	18,454	34,530‡	1,647	3,714

* Sold standing, no yield nor amount given.
† These acres are not included in the total acres of crops.
‡ The average price received was $1.85 per bushel. Sales here include $1000 for which the number of bushels was not reported.

TABLE 10 (*concluded*)

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Factory peas	4	44	Cwt	22	$ 72	22	$ 72
Peavines (cured)	...	11	Tons	...		...	...
Peavines (green)	1	2§	Tons	...	...	...	...
	...	37	Tons	...	...	...	
Field beans	5.2	130.5	Bushels	79.2	381	27.3	137
Bean refuse	...	1	Tons	...	...	...	...
Pop corn	1	76	Bushels	10	20	...	
Beets	5.3	61.8	Tons	2.7	46	...	...
Mangels	0.2	5	Tons	...	...	...	
Turnips †	(2)	9	Tons	...	...	...	
Pumpkins	1	13	Tons	13	65	...	...
Hops	15	12,170	Pounds	12,170	2,349	...	...
Apples ‖	89.3	...	Barrels	17	107	...	...
Strawberries	1.6	762	Quarts	762	188	...	...
Garden	0.3	...	...	...	...	...	...
1920 mixed hay (other)	...	...	Tons	66	1,145	...	
1920 timothy	...	...	Tons	7	92		...
1920 hops	...	...	Pounds	15,190	2,810		...
Total	7,689.5	...	...	...	$114,207	...	$12,018

† These acres are not included in the total acres of crops.
§ Peas are included with the vines.
‖ Most of the orchards of this area consisted of scattered trees, and the yields were not ascertained.

Some of the average yields per acre were: corn for the silo, 13.4 tons; oats, 30.7 bushels; oats and barley, 39.8 bushels; barley, 27.6 bushels; winter wheat, 24 bushels; oats for hay, 1.2 tons; mixed hay (clover), 1.9 tons; mixed hay (other), 1.2 tons; timothy, 1.6 tons; potatoes, 132 bushels; cabbage, 10.8 tons; market peas, 146 bushels.

The crop index is a number that represents the relative crop yield as compared with the average yield of the same crop in New York. On this basis, yields on these farms were 119 per cent of the average state yields. The index for corn for the silo was 216, for oats 93, and for all hay 102. The year was very favorable for corn, and the valley soil in this area is exceptionally well adapted to the production of corn for the silo. If the indexes for silage corn, oats, clover mixed hay, other mixed hay, and timothy, were weighted according to the proportion of the work units spent on each crop, the net weighted index for these crops would be 150.

Of the acres of corn ensiled, 26.2 per cent was Luce's Favorite, 16.8 per cent was Sweepstakes, 13.3 per cent was Eureka, and the remaining 43.7 per cent comprised at least twenty other varieties. The varieties used are listed in table 11:

TABLE 11. SUMMARY OF VARIETIES OF CORN FOR THE SILO, 112 FARMS

Variety	Acres	Per cent
Luce's Favorite	254.5	26.2
Sweepstakes	163.8	16.8
Eureka	129	13.3
Leaming	122	12.6
West Branch	101	10.4
West Branch, Sweepstakes	42.8	4.4
Pride of the North	27	2.8
Pride of Nishua	18.2	1.9
Golden Ensilage	18	1.8

TABLE 11 (*concluded*)

Variety	Acres	Per cent
Early Wonder	17	1 8
Early Dent	11	1.1
Golden Dent	8	0.8
Big Crop	7	0.7
Long Island Dent	6	0.6
Red Dent	4	0.4
Mammoth White Dent	4	0.4
White Cap Yellow Dent	3	0.3
Golden Nugget	3	0 3
Golden Glow	1	0 1
Early Michigan	1	0.1
Canadian	1	0.1
Golden Mine	1	0.1
Big Crop Ensilage	1	0.1
Early Northern Dent	1	0 1
Kinds not found	27	2.8
Total	972 3	100.0

Of the 121 farms 112 had silos, 30 having two silos each and 3 having three silos each. The dimensions of 134 cylindrical silos and of 12 rectangular and octagonal silos are given in table 12:

TABLE 12. SUMMARY OF NUMBER OF SILOS OF EACH SIZE, 112 FARMS*

Height of silos, in feet	Diameter of silos, in feet												Total silos†
	9.5	10	12	13	14	14.5	15	16	17	17.5	18	20	
	Number of silos												
22	..	..	..	..	2	..	..	..	..	..	..	..	2
24	..	1	4	..	4	..	..	3	..	..	1	..	13
25	..	..	1	..	..	.	..	..	..	..	..	..	1
26	..	..	8	..	10	..	2	2	.	..	..	..	22
27	..	..	3	..	..	..	..	..	..	..	..	1	4
28	..	..	3	1	6	..	1	6	..	..	2	..	19
29	..	.	.	.	2	1	..	..	..	.	..	..	3
30	..	1	3	2	11	..	..	3	..	1	1	..	22
31		..	.	..	4	..	..	.	..	..	..	..	4
32	.	.	2		5	..	2	6	..	..	1	1	17
33	1	..	1	..	6	..	1	..	..	..	..	..	9
34	.	..	1	..	2	..	..	3	1	..	..	..	7
35	..	..	.	..	..	1	..	3	..	..	..	..	4
36	..	..	.	..	2	..	..	3	..	.	..	..	5
42	.	..	..	.	..	.	..	1	..	..	..	..	1
44	..	.	..	..	..	..	..	1	..	..	..	..	1
Total	1	2	26	3	54	2	6	31	1	1	5	2	134

* On 2 farms of the 112 that had silos, the size of the silo was not found; 30 farms had two silos each, and 3 had three silos each.

† In addition to the round silos, there were five rectangular silos of the following dimensions: one each 10 x 10 x 20 feet, 14 x 16 x 28 feet, 16 x 16 x 26 feet; two each 16 x 16 x 30 feet. There were also seven octagonal silos of the following dimensions: one each 12 x 30 feet, 13 x 26 feet, 13 x 31 feet, 14 x 28 feet, 14 x 30 feet; two each 15 x 30 feet.

LIVESTOCK

Statements of the inventories, purchases, sales, and deaths of cattle and other livestock appear in tables 13 and 14

The average numbers, from the inventories, of the most important animals per farm were as follows. cows, 22.6; heifers one year old or over, 5.4; heifers under one year, 4 5; bulls, 1 1; horses, 3.7; chickens, 76.

The average value of horses was $145 per head. The depreciation was $6650, or 10 2 per cent of their average value Six colts were put to work during the year. Practically all of the horses are replaced by purchase.

There were five farms with 76 sheep at the beginning of the year. Nine farms kept 14 brood sows.

Of the receipts from livestock sold, 91.9 per cent was from cattle.

Of the average number of cows on hand, 840, or 30 7 per cent, were purebred; of the heifers one year old or over, 53.8 per cent were purebred; of the heifers under one year old, 57.3 per cent were purebred; and of the bulls, 79.9 per cent were purebred. The tendency has been to increase the number of purebreds

The purebred-cattle industry has had as concentrated a development in this area about Sherburne and Earlville, and from there north into Madison County, as in any section of New York. A number of high-producing animals have been developed, including DeKol Queen LaPolka, the one-time world-record cow for daily and seven-day milk production.

Some of the cows sold are sent to counties in New Jersey that are near New York City. The demand for milk is so great that these cows are milked out and not rebred. Most out-of-state buyers prefer not to buy of dealers who usually have transient cows. However, they are often put in contact with sellers thru a buyer's agent who receives a commission or a per-head fee for his services. This agent accumulates all the desires to sell which reach him during the intervals between buyers' visits, and therefore knows which farmers are most anxious to sell. Being paid by the purchaser, the agent can assist him in buying to an advantage. Due to the increase in demand for cows that can be shipped interstate, and the increased reluctance of out-of-town buyers to purchase without regard to test, more dairymen have become interested in testing their cows for tuberculosis.

Poultry are kept chiefly as farm flocks. There were 4 flocks of more than 200 each at the beginning of the year.

Poultry and egg dealers in Sherburne and Earlville make two trips a week to the farms in July and August, for collecting eggs, and one trip a week during the rest of the year. During July and August, the poultry is shipped to the Jewish trade in the Catskill Mountain region, and the eggs are shipped mostly to New York City. The mountain boarders are very insistent that eggs be strictly fresh. The gatherings from small flocks are not made often enough, are not given sufficient care on the farm, or are not collected and placed at the point of consumption quickly enough, to satisfy the demands of this trade. Such eggs will, however, net fair prices in the city, and for farmers who have less than a case of

TABLE 13. Appreciation and Depreciation on Dairy Cattle, 121 Farms

	Cows						Heifers											
	Grade			Purebred			Grade						Purebred					
							One year or over			Under one year			One year or over			Under one year		
	Number of farms	Number of cows	Value	Number of farms	Number of cows	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value
On hand May 1, 1921	97	1,850	$157,095	64	786	$138,844	75	309	$14,580	56	214	$4,631	53	320	$39,219	48	310	$23,078
Purchased during year	33	201	16,805	16	73	11,663	13	39	2,090	6	24	600	13	47	6,619	7	15	623
Born during year										64	261	1,023				56	317	9,699
Heifers that became cows	78	286	19,392	50	247	40,100												
Total			$193,292			$190,607			$16,670			$6,254			$45,838			$33,400
Sold	67	340	$ 22,023	31	204	$ 32,189	1	1	$ 28	3	14	$ 45	10	39	$ 6,410	16	51	$ 2,336
Died or killed by accident	28	49*	100	8	8†	50	3	4		1	1		2	2		2	4	
Hides sold	13	23	78				1	1	6	1	1	2						
Heifers that became cows							78	286	19,392				50	247	40,100			
Used for food	6	7	208				1	1	40				1	1	32			
On hand May 1, 1922	103	1,941	165,710	70	894	156,108	71	291	12,614	63	249	4,869	54	380	48,171	57	312	21,070
Total			$188,119			$188,347			$32,080			$4,916			$94,713			$23,406
Appreciation							$52,953											
Depreciation	$7,433																	

* Including two killed by lightning, indemnity $100.
† Including one killed by lightning, indemnity $50.

TABLE 13 *(concluded)*

	Herd bulls						Veals			Bull calves to be sold		
	Grade			Purebred								
	Number of farms	Number of bulls	Value	Number of farms	Number of bulls	Value	Number of farms	Number of veals	Value	Number of farms	Number of bull calves	Value
On hand May 1, 1921	24‡	23.5	$765	87§	105.6	$22,721						
Purchased during year	6	7	219	20	21	2,558				1	2	$ 55
Born during year	7	8	23	9	12	355	117	1,770	$4,653	10	32	652
Heifers that became cows												
Total			$1,007			$25,634			$4,653			$707
Sold	6	6	$269	25	32	$ 2,829	117‖ { 25 113 }	139 1,628	$1,584 4,464	7	20	$ 980
Died or killed by accident												
Hides sold	3	3	8	1	1	2						
Heifers that became cows												
Used for food	3	3	120	2	2	90	2	3	41			
On hand May 1, 1922	26‡	29.5	870	88§	104.6	21,510				7	14	1,103
Total			$1,267			$24,431			$6,089			$2,083
Appreciation								$1,436			$1,376	
Depreciation			$943									

‡ Six farms had 6 grade bulls for keep, value not included.
§ Five farms had 5 purebred bulls for keep, value not included.
‖ 25 farms sold 139 fat veals, and 113 farms sold 1628 veals at birth.

TABLE 14. SUMMARY OF LIVESTOCK OTHER THAN DAIRY CATTLE, 121 FARMS

	Inventory at beginning of year			Purchases			Sales			Inventory at end of year			Died		Used for food		
	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Number of farms	Number of head	Value
Horses *	121	442	$66,245	20	29	$4,157	16	21*	$2,290	121	439	$62,007	16	17†	......	......	......
Mules	4	6	700	1	2	185	......	......	......	4	7	975	1	1	......	......	......
Colts	15	24	2,560	1	2	200	......	......	......	14	21	2,425	2	2	......	......	......
Stallions	2	2	550	......	......	......	......	......	......	2	2	550	......	......	......	......	......
Ponies	......	......	......	1	1	25	......	......	......	1	1	25	......	......	......	......	......
Sheep, ewes	3	74	416	......	......	......	2	4	40	3	72	423	1	3	......	......	......
Sheep, bucks	2	2	36	......	......	......	1	1	25	1	1	7	......	......	......	......	......
Lambs, weaned	......	......	......	......	......	......	3	69	457	......	......	......	......	......	1	1	$ 3
Brood sows	9	14	430	......	......	......	5	6	182	8	11	435	......	......	2	3	80
Boars	1	1	25	......	......	......	......	......	......	1	1	25	......	......	......	......	......
Other hogs	17	34	538	12	22	205	8	9 5	269	24	45	874	1	2	42	76 5	2,618
Pigs, weaned	4	7	61	31	68	385	8	85	454	3	27	138	......	......	......	......	......
Chickens	112	8,487	11,727	7	828	790	41	3,384	2,620	113	9,952	13,292	......	......	......	......	......
Baby chicks	......	......	......	15	2,238	382	1	20	4	......	......	......	......	......	......	......	......
Turkeys	1	2	12	2	6	55	1	3	18	3	8	68	......	......	......	......	......
Ducks	3	11	16	1	3	2	2	82	58	5	27	39	......	......	......	......	......
Guinea hens	1	4	8	......	......	......	......	......	......	1	4	8	......	......	......	......	......
Bees ‡	2	15‡	324	......	......	......	......	......	......	2	22‡	506	......	......	......	......	......
Total	......	......	$83,648	......	......	$6,386	......	......	$6,417	......	......	$81,797	......	......	......	......	$2,701

* Includes one horse given away, **value** not included.
† One horsehide sold for $5.
‡ Two farms had 15 colonies of bees at the beginning of the year, and 22 colonies at the end of the year.

eggs this method of marketing provides a convenient way to dispose of them at a fair price.

The adjustment between supply and demand in the poultry business is made, not so much by a few specialized poultrymen entering or leaving the business in a commercial way, as by an increase or a decrease in the size of many farm flocks The high prices for eggs and the relatively low prices for corn and wheat, for the three years preceding 1924, encouraged a rapid expansion in the poultry enterprise on farms. The result of this over-expansion will be a discontinuation of the business by some who entered it on a small scale.

The difference in the degree of success achieved with poultry is due more to the difference in income from the birds than to the difference in cost. The advantage of raising the chicks in large flocks, and with coal-burning hovers, is quickly realized. Differences in the feed consumption per bird do occur, but they have little effect on the success or the failure of the business. It is the difference in income that determines who continues, and the income depends more on proper feeding and proper care than on anything else.

MILK SOLD

The Dairymen's League Cooperative Association, Inc., began its milk-pooling operations on May 1, 1921, the beginning of the year covered by this study.

The number of farmers, the amount of milk sold by each group, the monthly production, the average butterfat test, and the income from the sales of milk for the farms selling thru the Cooperative Association and for those selling directly to dealers, are given in table 15.

The average price per 100 pounds received for all milk sold thru the Dairymen's League Cooperative Association, Inc., was $1.98 for the pasture period, $2.01 for the winter period, and $2 for the year. The average price per 100 pounds received for milk sold directly to dealers was $2.32 for the pasture period, $2.51 for the winter period, and $2.41 for the year. The average price received for all milk sold thruout the year was $1.97 in cash and 13 cents in certificates of indebtedness. In addition to the pool price given, 1.32 cents per 100 pounds was returned to poolers on December 13, 1922, to cover unpaid amounts from May 1, 1921, to March 31, 1922.[4]

The monthly distribution of the production of milk, the average butterfat test, and the monthly receipts from milk sold, for all farms, are given in table 16. The butterfat test averaged 3.3 per cent for the year, but ranged from 3.3 to 3.5 per cent. A slightly larger proportion of the milk was produced from September to February, inclusive, than was produced for the same months at some of the other regions reported in the preceding bulletins of this series.

The income from milk was lowest ($176 per farm) in July and was highest ($283 per farm) in December. Of the total income from milk sold, 41 per cent was received in the pasture period and 59 per cent in the winter period.

[4] All figures for gain or loss given in this bulletin should be corrected by this amount. It was not known how much the amount would be when the records were summarized.

TABLE 15. RETURNS FROM MILK SOLD WHOLESALE, 121 FARMS

	Milk pooled*									Milk not pooled					
	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butter-fat	Amount dealer paid for milk	Amount received by farmers for milk: Certificates of indebtedness	Amount received by farmers for milk: Cash	Amount received by farmers for milk: Total	Amount received by farmers for milk: Total per 100 pounds	Number of farms selling milk	Number of pounds of milk sold wholesale	Number of pounds of fat in milk sold wholesale	Average per cent of butter-fat	Amount dealer paid for milk	Amount received by farmer for milk per 100 pounds
1921:															
May (pasture)	...	713,375	23,583	...	$14,109	$ 715	$11,964	$12,679	...	...	302,641	10,223		$ 6,186	..
May (winter)	...	505,490	16,614	...	9,873	504	8,528	9,032	...	...	243,236	8,583	..	4,807	..
June (pasture)	...	1,088,821	35,671	.	19,258	1,094	15,271	16,365	..	...	435,988	11,570	..	8,072	..
June (winter)	...	...				...	...	...	..	...	3,750	128	.	67	
May (total)	84	1,218,865	40,197	3.3	23,982	1,219	20,492	21,711	$1 78	36	545,877	18,806	3 4	10,993	$2 01
June (total)	88	1,088,821	35,671	3 3	19,258	1,094	15,271	16,365	1 50	32	439,738	11,698	3 3	8,139	1 85
July	88	800,882	26,557	3 3	16,969	807	13,546	14,353	1.79	31	330,148	11,165	3 4	6,926	2 10
August	92	802,591	27,066	3 4	21,418	1,605	16,503	18,108	2.26	28	272,070	9,311	3 4	7,211	2 65
September (pasture)	...	731,692	24,754	...	20,632	1,463	15,668	17,131	...	...	227,812	7,850	...	6,456	
September (winter)	...	11,421	355	...	314	23	232	255	...	...	...	...	.	.	
October (pasture)	...	535,805	18,466	..	16,449	1,074	12,723	13,797	...	...	184,227	6,426	..	5,770	.
October (winter)	...	295,167	10,557	...	8,967	589	7,002	7,591	...	...	65,576	2,325	.	2,032	
November (pasture)	...	9,724	314	...	313	19	222	241	...	...	..	.			...
November (winter)	...	889,538	30,124	...	28,696	1,775	20,858	22,633	...	...	262,612	8,970	.	7,965	.
September (total)	95	743,113	25,109	3 4	20,916	1,486	15,900	17,386	2 34	26	227,812	7,850	3 4	6,456	2 83
October (total)	93	830,972	29,023	3 5	25,116	1,663	19,725	21,388	2 57	28	249,803	8,751	3 5	7,802	3.12
November (total)	93	899,262	30,438	3.4	29,009	1,794	21,080	22,874	2 54	28	262,612	8,970	3 4	7,965	3 03
December	95	1,045,414	35,032	3.4	32,701	2,089	24,036	26,125	2 50	26	264,999	8,944	3 4	8,179	3.09
1922:															
January	95	1,117,670	36,874	3 3	30,043	2,236	22,257	24,493	2 19	24	265,133	9,168	3 5	7,467	2.82
February	96	1,052,075	35,106	3 3	26,756	2,103	19,355	21,458	2 04	23	243,168	8,247	3 4	6,421	2 64
March	99	1,297,720	42,872	3 3	23,103	2,574	19,170	21,744	1 68	21	237,168	8,057	3 4	4,489	1.89
April	102	1,356,882	44,094	3 2	22,970	1,372	17,751	19,123	1 41	18	233,267	7,932	3 4	4,182	1 70
Total.															
Pasture	...	4,682,890	156,411	3 3	$109,148	$6,777	$85,897	$92,674	$1 98	...	1,752,886	59,545	3 4	$40,621	$2 32
Winter	...	7,571,377	251,628	3 3	$183,426	$13,265	$139,189	$152,454	$2 01	...	1,818,909	62,354	3 4	$45,609	$2 51
Year	...	12,254,267	408,039	3.3	$292,574	$20,042	$225,086	$245,128	$2 00	...	3,571,795	121,899	3 4	$86,230	$2.41

* Milk pooled is that sold thru the Dairymen's League Cooperative Association, Inc. The buyers paid the Cooperative Association directly for this milk, and the producers received the net pool price paid by the Association. The "Amount dealer paid for milk" represents the money which the buyers paid to the Cooperative Association for milk delivered to them by members, or paid directly to farmers not affiliated with the Cooperative Association

ıtal milk sold during the year, 77 per cent was sold thru the ; Association. At the beginning of the year, 84 of the 121 e selling thru the Cooperative Association, and 36 were selling dealers. At the end of the year, in April, 102 were selling ɔoperative Association, and only 18 were selling directly to

BLE 16. DISTRIBUTION OF MILK PRODUCTION, 121 FARMS

	Total pounds of milk sold wholesale	Per cent	Butter-fat test	Value per farm, including certificates of indebtedness
....	1,764,742	11.2	3.3	$270
....	1,528,559	9.7	3.3	203
....	1,131,030	7.1	3.3	176
....	1,074,661	6.8	3.4	209
....	970,925	6.1	3.4	197
....	1,080,775	6.8	3.5	241
....	1,161,874	7.4	3.4	255
....	1,310,413	8.3	3.4	283
....	1,382,803	8.7	3.3	264
....	1,295,243	8.2	3.3	230
....	1,534,888	9.7	3.3	217
....	1,590,149	10.0	3.3	193
....	15,826,062	100.0	3.3	$2,738
e......................	6,435,776	40.7	3.4	$1,101
....	9,390,286	59.3	3.3	$1,637

ırence between the pool prices paid by the Dairymen's League e Association, Inc., and the prices paid by the milk buyers, alled non-pool prices, was greater in the winter months than in r months. Two reasons for this are that in the summer the has the returns from a larger volume of milk over which to ɔost of operation, and that in the winter it does not enjoy the ıtages of so large a proportion of city fluid to total milk handled ity distributers. The winter dairyman who is a member of the , therefore, has less incentive to carry on his farm activities as as formerly than does the summer dairyman. The inevitable e of this disturbance in price balance must be a decreased pro- winter milk. The amounts per 100 pounds received by non- rs above the amounts, on the same fat basis, received by f the Association were: May, 19 cents; June, 35 cents; July, August, 39 cents; September, 49 cents; October, 55 cents; 49 cents; December, 59 cents; January, 55 cents; February, Aarch, 17 cents; April, 30 cents; average for the five months, ptember, 34 cents; average for the five months, October to 55 cents; yearly average, 37 cents.

MISCELLANEOUS RECEIPTS

The miscellaneous receipts were chiefly for eggs, wood, and labor away from the farm. They amounted to $280 per farm (table 17).

TABLE 17. MISCELLANEOUS RECEIPTS, 121 FARMS

	Amount	Price	Value		
			Farm	Operator	Landlord
Human labor off farm	502.5 days	$ 4.58	$ 2,301	$2,301	......
Horse labor off farm	349 days	2.34	818	818	......
Use of machinery	129.5 days	9.75	1,262	1,250	$ 12
Rent of house	24 months	6.08	146	146	......
Rent of rooms	....	......	156	156	......
Rent of pasture	....	......	306	288	18
Maple sirup	436 gallons	1.80	783	743	40
Maple sugar	50 pounds	0.22	11	11	......
Honey	965 pounds	0.22	215	202	13
Cider	400 gallons	0.25	100	100	......
Lumber	59.7 thousand feet	29 01	1,732	1,522	210
Wood	655.2 cords	3.72	2,439	2,414	25
Logs	....	......	47	47	......
Gravel	3,014 yards	0.30	897	897	......
Wool	770 pounds	0.28	216	216	......
Eggs	54,016.5 dozen	0.38	20,505	20,055	450
Baby chicks	2,478	0.18	446	446	......
Feed bags	7,230	0.03	223	208	15
Hauling milk	....	......	15	15	......
Breeding fees	....	......	303	301	2
Board of cattle	225	1.00	225	225	......
Ice	....	......	250	250	......
Premiums at fair	....	......	105	105	......
Hides	122	1.52	186	164	22
Insurance	1	50.00	50	50	......
Lightning indemnity	2	50.00	100	100	......
Total	....	......	$33,837	$33,030	$807
Per farm	....	......	$280	$273	$7

The reduced after-the-war income has encouraged the farmers to work harder to make ends meet. Some have plowed pasture lands never worked before, others have sold wood, and still others have done custom work of various kinds.

FARM EXPENSES

The operating expenses per farm amounted to $3413, of which 32 per cent was for cattle and horse feed, 28 per cent was for labor, 6 per cent was for taxes, 6 per cent was for new machinery and repairs to machinery, and the remaining 28 per cent was for other items (table 18). The expenses for new buildings amounted to $126 per farm, and the livestock purchased to $393 per farm, making a total expense of $3932 per farm.

When the balance between costs of production and price is disturbed, depression results. It may be due either to relatively high costs or to

›rices, or to both. Whatever the cause, it is necessary to ne economy during periods of depression. Since the expended for the production of feed for cows, and of milk, n prices fall and farm wages lag it becomes more important operation efficient

rms, thirteen used trucks of the following makes Ford, 9; odge, 2; Republic, 1. Thirteen farms had tractors of the s: Fordson, 7; Cletrac, 3; Waterloo Boy, 1; International,

TABLE 18. EXPENSES ON 121 FARMS

	Value		
	Total	Per farm	Per cent
	$ 65,573	$ 542	15.9
	32,639	270	7.9
oor	15,889	131	3.8
l	12	.....	..
	237	2	0.1
	228	2	0.1
crates, etc	2,973	25	0.7
	757	6	0.2
	219	2	0.1
	10,536	87	2.6
	1,279	11	0.3
	2,808	23	0.7
ess	4,715	39	1.1
	195	2	0.1
	1,654	14	0.4
	209	2	0.1
v, stalks	2,660	22	0.6
feed	7,886	65	1.9
feed	130,068	1,075	31.5
	1,338	11	0.3
s, etc	2,877	24	0.7
	9,727	80	2.4
nd)	2,609	22	0.6
	159	1	......
or stable use	51	......	......
	5,193	43	1.3
	5,126	42	1.2
	1,647	14	0.4
)	15,114	125	3.7
inery	7,664	63	1.9
	798	7	0.2
	3,410	28	0.8
	2,212	18	0.5
e, for farm use	6,558	54	1.6
	1,409	12	0.3
›keep and operation of automobile	8,923	74	2.2
; for ice	811	7	0.2
	1,687	14	0.4
ns	10	......	......
ers, pails, etc	1,824	15	0.4
, fees	1,209	10	0.3
	591	5	0.1
gue deduction	169	1	......

TABLE 18 (*concluded*)

	Value		
	Total	Per farm	Per cent
Grass seed	$ 6,063	$ 50	1.5
Other seeds and plants	5,944	49	1.4
Spray materials	671	6	0.2
Stamps, stationery, for farm use	165	1	.....
Telephone, farm use	1,819	15	0.4
Taxes, including school tax	25,648	212	6.2
Veterinary, medicine	2,894	24	0.7
Electric lights and carbide	667	6	0.2
Buttermilk	5	......	.....
Coal, cloth, brimstone, for hops	80	......	.....
Electric plant	735	6	0.2
Water piping	200	2	0.1
Water (city)	20	......	.....
Sirup cans	22	......	.....
House rent	30	......	.....
Board of cattle	100	1	.....
Honey caps	57	......	.....
Any other farm expense	6,178	51	1.5
Total (except cash rent and new buildings)	$412,951	$3,413	100.0
Cash rent	2,145	......	......
New buildings:	15,212	126	......
Operator	(9,661)	......	......
Landlord	(5,551)	......	......
Total	$430,308	......	......
Livestock purchased:	47,618	393	......
Operator	(39,964)	......	......
Landlord	(7,654)	......	......
Total (except cash rent)	$475,781	$3,932	......

Larger fields, larger teams, and special labor-saving arrangements, should be developed on many farms in order to reduce labor expenses. If the sons are not attending school, and more than are needed remain at home, some had better start as hired men for neighbors who are not so fortunate. The sons will then be ready to become tenants or owners when the depression in farming is past. Feed, gasoline, oil, hardware, and all farm materials should be purchased wholesale in quantities, whenever possible, in order to get them at the lowest price. Farmers should strive also to derive more of their own living from the farm, and thus avoid buying from a highly organized market.

LABOR INCOMES

The return which a farmer receives as pay for his year's labor and management constitutes his labor income. This income represents the amount of money left after paying all farm expenses and deducting the interest on the investment, and is in addition to the use of the dwelling and the products furnished by the farm toward the family living.

The total receipts on these farms were $5082, and the total expenses were $3932. The difference, or farm income, would thus be $1150. The interest on $16,586 at 5 per cent amounts to $829, leaving $321 as the average labor income of the 121 operators.

The average cash living costs of 121 operators' families were: $379 for food, $196 for clothing, and $241 for other expenses; making a total of $816 per farm, or $68 per month.

The net income can be expressed in terms of interest on the investment by deducting from the farm income of $1150, the value of the operator's time, $1012, leaving $138, which represents 0.8 per cent, or slightly less than 1 per cent, return on the capital.

The labor income as found by averaging the figures recalculated at the pool-milk price for all milk not sold thru the Cooperative Association was $209 in contrast to $321 as found. It is necessary to recalculate this labor income in order to make a fair comparison with that of other regions included in this study.

COSTS AND RETURNS IN PRODUCING MILK

The costs in producing milk are as follows: concentrates, succulent feed, dry forage, pasture, bedding, labor, hauling milk, use of buildings, use of equipment, interest, depreciation on cows, bull service, and miscellaneous charges. The returns are for milk and milk products, calves born during the year, manure, and miscellaneous returns.

COSTS

Concentrates

The average value of home-grown grain was $33.54 per ton, of purchased concentrates $38.28 per ton, and of all concentrates used $37.53 per ton (table 19). Of the grain feeds used by cows in the winter period, 25.2 per cent was gluten feed. The feeds used in the next largest amounts were various straight by-product feeds, as wheat bran, hominy, and oil-meal. Of the total grains and concentrates used by cattle and horses on the 121 farms, 16 per cent was home-grown and 84 per cent was purchased. Of the grain used by horses, 59 per cent was home-grown and 41 per cent was purchased.

The charge for concentrates used in producing milk was $41.85 per cow, or 73 cents per 100 pounds of milk sold.

Succulent feed

The average of the estimates for the value of corn silage per ton was $5.61. The average value of all succulent feed used was $5.54 per ton. The data are given in table 20.

Of the succulent feed used supplementary to pasture, 54 per cent was silage; the remainder was corn fed green, cabbage refuse, and various kinds of soiling crops.

The charge for succulent feed averaged $24.47 per cow, or 42 cents per 100 pounds of milk sold.

Dry forage

The average value of all hay used was $15.75 per ton, and the average value of straw and stover used was $4.82 per ton (table 21). The charge

TABLE 19. CONCENTRATES USED BY 2749 COWS, 1192 HEIFERS, 132 HERD BULLS, AND 447 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (cwt.)	Average price per ton	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value
Home-grown:													
Corn for grain	2,410	$28.44	$ 3,427	......	......	1,806	$2,515	82	$130	8	$13	514	$ 769
Corn for grain, surplus silage	268	32.46	435	......	......	162	277	49	64	9	15	48	79
Oats	7,375	34.51	12,725	33	$51	1,361	2,268	550	978	42	66	5,389	9,362
Oats, 1920	151	33.91	256	......	......	......	......	10	20	......	......	141	236
Oats and barley	1,612	34.80	2,805	......	......	360	638	113	194	3	5	1,136	1,968
Oats, barley, and buckwheat	54	34.81	94	......	......	......	......	......	......	......	......	54	94
Barley	961	36.92	1,774	21	39	454	837	98	186	2	4	386	708
Buckwheat	12	33.33	20	......	......	10	15	......	......	......	......	2	5
Total home-grown	12,843	$33.54	$21,536	54	$90	4,153	$6,550	902	$1,572	64	$103	7,670	$13,221
Purchased:													
Cornmeal	2,221	$32.13	$ 3,568	564	$ 878	1,146	$ 1,825	164	$ 288	17	$ 31	330	$ 546
Hominy*	6,331	32.41	10,259	1,031	1,675	3,648	5,878	1,091	1,789	124	204	426	697
Ground corn and oats	4,321	34.61	7,478	253	415	1,622	2,721	184	317	53	84	2,209	3,941
Cracked corn	281	31.81	447	......	......	......	......	......	......	......	......	281	447
Whole corn	231	29.70	343	......	......	8	19	......	......	......	......	223	324
Whole oats	396	38.18	756	......	......	......	......	43	73	......	......	353	683
Ground oats	4,872	36.06	8,783	562	1,038	2,686	4,830	730	1,315	98	174	796	1,426
Ground oats and barley	194	35.05	340	8	14	59	103	38	67	......	......	89	156
Ground corn, oats, and barley	16	32.50	26	......	......	......	......	......	......	16	26	......	......
Buckwheat middlings	5	28.00	7	......	......	4	6	1	1	......	......	......	......
Molasses	1,061	31.29	1,660	99	164	896	1,389	53	84	13	23	......	......
Wheat	7	37.14	13	......	......	......	......	2	4	5	9	......	......
Wheat bran*	9,054	30.26	13,698	1,568	2,485	5,634	8,489	1,302	1,941	171	252	374	526
Wheat feed*	1,539	33.18	2,553	242	410	885	1,478	320	506	26	45	60	106
Wheat middlings	250	33.36	417	6	12	206	338	34	59	4	8	......	......
Gluten feed*	15,912	40.15	31,944	2,575	5,160	12,702	25,509	544	1,089	76	156	......	......
Cottonseed meal	2,141	50.66	5,423	195	500	1,867	4,713	65	172	14	38	......	......
Oilmeal*	4,245	55.26	11,728	495	1,390	3,036	8,282	600	1,740	67	181	39	108
Calf meal	9	84.44	38	......	......	......	......	9	38	......	......	......	......
Schumacher	160	33.75	270	......	......	......	......	......	......	......	......	160	270
Barnett and Conklin Milk Maker Dairy Feed	4,863	41.57	10,107	508	1,076	4,242	8,794	98	205	15	32	......	......
Armour's Dairy Feed	1,530	40.05	3,064	380	760	1,150	2,304	......	......	......	......	......	......
Distillers' dried grains	1,386	47.03	3,259	98	246	1,249	2,917	29	73	10	23	......	......
Cornell Ration	1,150	42.21	2,427	251	529	817	1,728	69	142	13	28	......	......
Tom Gaines' Gainesmore Ration	1,004	39.40	1,978	145	287	843	1,660	12	23	4	8	......	......
Summit	827	45.01	1,861	40	90	784	1,764	......	......	3	7	......	......
Beet Pulp	818	36.97	1,512	4	7	789	1,464	22	36	3	5	......	......
Armour's Stock Feed	539	31.99	862	......	......	......	......	481	769	58	93	......	......

TABLE 19 (*concluded*)

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (cwt.)	Average price per ton	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value
Purchased (*concluded*):													
Armour's Dairy Ration	468	$40.00	$936	......	......	468	$936	......	......	......	......	......	......
Arcady Dairy Feed	369	46.02	849	106	$244	257	591	......	......	6	$14	......	......
Purina Cow Chow	369	46.02	849	106	244	257	591	......	......	6	14	......	......
Other mixed feed	325	40.00	650	14	28	290	580	8	$16	13	26	......	......
International Molasses Feed	220	32.91	362	......	......	210	347	4	6	6	9	......	......
Beechwood's Masters' Grain	214	45.05	482	44	99	128	288	42	95	......	......	......	......
Madison Dairy Feed	141	47.66	336	17	51	124	285	......	......	......	......	......	......
Eaton's Climax	140	29.00	203	140	203	......	......	......	......	......	......	......	......
Armour's Balanced Ration	120	35.00	210	20	35	100	175	......	......	......	......	......	......
The H. O. Company's Milk Feed with Molasses	72	33.06	119	34	56	38	63	......	......	......	......	......	......
Coconut meal	51	31.37	80	1	1	42	65	7	12	1	2	......	......
Cloverleaf Dairy Feed	48	30.83	74	......	......	48	74	......	......	......	......	......	......
Empire Leader Dairy Feed	27	22.96	31	......	......	24	28	3	3	......	......	......	......
Sugared Schumacher	20	32.00	32	......	......	20	32	......	......	......	......	......	......
Larro	10	68.00	34	10	34	......	......	......	......	......	......	......	......
Total purchased *	67,957	$38.28	$130,068	9,516	$18,131	46,279	$90,266	5,955	$10,863	822	$1,492	5,340	$9,230
Total concentrates *	80,800	$37.53	$151,604	9,570	$18,221	50,432	$96,816	6,857	$12,435	886	$1,595	13,010	$22,451

* Bull calves to be sold were fed: 11 hundredweight of hominy, valued at $16; 5 hundredweight of wheat bran, valued at $5; 6 hundredweight of wheat feed, valued at $8; 15 hundredweight of gluten feed, valued at $30; and 8 hundredweight of oilmeal, valued at $27.

TABLE 20. Succulent Feed Used by 2749 Cows, 1192 Heifers, 132 Herd Bulls, and 447 Horses

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Corn silage	12,037.5	$ 5.61	$67,534	359	$2,012	9,896.5	$55,522	1,581.7	$8,872	198.3	$1,117	2	$11
Corn silage, 1920	667	5.61	3,742	579	3,247	87	489	1	6	...	...	...	...
Oat and pea silage	34	7.00	238	8	56	15	105	10	70	1	7	...	...
Corn, green	245	4.56	1,118	240	1,098	5	20	...	...	...	...	...	...
Sweet corn	20	4.00	80	20	80	...	...	...	...	...	...	...	...
Corn and millet	5	5.00	25	5	25	...	...	...	...	...	...	...	...
Potatoes	26.6	5.00	133	...	...	14	123	0.6	5	...	...	12	5
Cabbage	5	10.00	50	...	...	5	50	...	...	...	...	...	...
Cabbage refuse	532.2	3.47	1,846	167	529	365.2	1,317	...	...	...	...	...	...
Turnips	0.9	8.89	8	...	...	0.9	8	...	...	...	...	...	...
Beets	51.9	9.00	467	...	...	50.3	444	1.6	23	...	...	...	...
Mangels	5	10.00	50	...	...	5	50	...	...	...	...	...	...
Peavine refuse	39	7.79	304	26.5	182	12.5	122	...	...	...	...	...	...
Bean refuse	1	3.00	3	...	...	1	3	...	...	...	...	...	...
Oats	17.5	7.54	132	16.7	124	...	...	...	...	...	...	0.8	8
Oats and peas	61	4.44	271	61	271	...	...	...	...	...	...	...	...
Oats and buckwheat	19	5.00	95	19	95	...	...	...	...	...	...	...	...
Oats and sudan grass	10	7.00	70	10	70	...	...	...	...	...	...	...	...
Oats and millet	5	8.00	40	5	40	...	...	...	...	...	...	...	...
Buckwheat	69.5	3.40	236	69.5	236	...	...	...	...	...	...	...	...
Millet	43	6.33	272	43	272	...	...	...	...	...	...	...	...
Millet and sudan grass	5	10.00	50	5	50	...	...	...	...	...	...	...	...
Sudan grass	20	6.50	130	20	130	...	...	...	...	...	...	...	...
Alfalfa, second cutting	20	7.00	140	20	140	...	...	...	...	...	...	...	...
Alfalfa, third cutting	17	6.24	106	17	106	...	...	...	...	...	...	...	...
Mixed hay	4	15.00	60	3	45	...	...	1	15	...	...	...	...
Rowen	27.5	7.20	198	27.5	198	...	...	...	...	...	...	...	...
Total home-grown	13,988.6	$5.53	$77,398	1,721.2	$9,006	10,457.4	$58,253	1,595.9	$8,991	199.3	$1,124	14.8	$24
Purchased:													
Skimmilk	22.9	$9.13	$209	...	...	...	...	22.9	$209	...	...	...	...
Corn silage	10	2.50	25		...	10	$25	...		...		...	...
Total purchased	32.9	$7.11	$234	...	...	10	$25	22.9	$209	...	...	...	...
Total succulent feed	14,021.5	$5.54	$77,632	1,721.2	$9,006	10,467.4	$58,278	1,618.8	$9,200	199.3	$1,124	14.8	$24
Total succulent feed except skimmilk	13,998.6	$5.53	$77,423	1,721.2	$9,006	10,467.4	$58,278	1,595.9	$8,991	199.3	$1,124	14.8	$24

TABLE 21. DRY FORAGE USED BY 2749 COWS, 1192 HEIFERS, 132 HERD BULLS, AND 447 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Alfalfa, first cutting	189.5	$17.98	$ 3,408	2	$ 40	176.5	$ 3,168	9	$ 168	1	$ 16	1	$ 16
Alfalfa, second cutting	96.5	18.36	1,772	10	182	80.5	1,470	6	120				
Alfalfa, third cutting	16	20.19	323	3	66	12	242	1	15				
Mixed hay (clover)	1,627.7	15.62	25,419	2	36	1,316	20,735	216.3	3,262	44.4	719	49	667
Mixed hay (other)	2,683.5	15.88	42,612	7	105	1,531.1	24,415	415.8	6,781	102.2	1,612	627.4	9,699
Rowen	215	16.72	3,595	10	150	185	3,115	15	230			5	100
Timothy	1,373	15.17	20,831			666	10,145	217	3,290	56	858	434	6,538
Oat hay	156	15.54	2,425			120	1,859	4.3	64	0.2	4	31.5	498
Oat and pea hay	60	13.93	836	8	64	50	742			2	30		
Millet hay	4.5	15.33	69			4.5	69						
Barley hay	6	10.00	60			5.5	54	0.5	6				
Sudan grass	9	15.00	135			7	105	1	15	1	15		
Clover hay, 1920	14	14.43	202			14	202						
Mixed hay (other), 1920	117.5	15.25	1,792	7	117	92	1,373	5.9	106			12.6	196
Timothy, 1920	29	14.48	420	9	135	16	227					4	58
Total hay	6,597.2	$15.75	$103,899	58	$895	4,276.1	$67,921	891.8	$14,057	206.8	$3,254	1,164.5	$17,772
Oat straw	56	$ 7.46	$418			39.5	$313	3.5	$ 20	2	$20	11	$65
Oat, pea, and barley straw	6.5	10.00	65			5	50			0.2	2	1.3	13
Barley straw	1	4.00	4			1	4						
Wheat straw	2	4.00	8			1	4	0.5	2			0.5	2
Corn stover	221.3	4.24	939	3	$ 15	196.8	863	21.5	61				
Corn for the silo (surplus fodder)	198	4.16	823	25	120	142	579	27.5	110	3.5	14		
Peavines, cured	11	12.00	132			11	132						
Total straw, stover, etc.	495.8	$4.82	$2,389	28	$135	396.3	$1,945	53	$193	5.7	$36	12.8	$80
Total home-grown	7,093	$14.98	$106,288	86	$1,030	4,672.4	$69,866	944.8	$14,250	212.5	$3,290	1,177.3	$17,852
Purchased:													
Alfalfa, second cutting	12	$18.83	$ 226			10.5	$ 207	1	$ 13	0.5	$ 6		
Mixed hay (clover)	16	15.00	240			6	90					10	$150
Mixed hay (other)	115.5	14.80	1,709			80	1,197	13.5	197	2	30	20	285
Rowen	4.5	22.22	100			4.5	100						
Timothy	16	14.69	235			12	170					4	65
Hay	12	8.33	100			12	100						
Oat straw	10	2.50	25			10	25						
Total purchased	186	$14.17	$2,635			135	$1,889	14.5	$210	2.5	$36	34	$500
Total dry forage	7,279	$14.96	$108,923	86	$1,030	4,807.4	$71,755	959.3	$14,460	215	$3,326	1,211.3	$18,352

for dry forage averaged $26.48 per cow, or 46 cents per 100 pounds of milk sold.

Quantities of feed used

The average pounds of feed used per cow for the year on the Earlville farms were: concentrates, 2183 pounds; succulent feed, 8868 pounds; dry forage, 3560 pounds. The acres of pasture averaged 3.3 per cow. (Table 22.) The average amount of feed used per cow per day and per unit of product during the winter period, and per unit of product during the

TABLE 22. AMOUNTS OF FEED USED PER COW AND PER UNIT OF PRODUCT, FOR THE YEAR, IN POUNDS

	Per cent of cows freshening from September to December, inclusive						All herds	
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent			
	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced	Per cow	Per 100 pounds of milk produced
Concentrates	1,668	32.1	2,370	38.4	2,324	33	2,183	35.3
Silage	5,480	105.3	8,777	142.4	8,749	124.3	7,953	128.6
Other succulent feed	596	11.5	1,187	19.3	758	10 8	915	14 8
Dry forage	3,721	71.5	3,504	56.8	3,513	49.9	3,560	57.6
Days of pasture	160	3.1	161	2.6	160	2.3	160	2.6
Acres of pasture	3.3	.....	3.3	......	3.3	......	3.3	......

pasture period, is shown in table 23. The quantities per 100 pounds of milk indicate heavier feeding on these farms than on those reported in other areas. This is due to the large proportion of purebreds in the area.

TABLE 23. AMOUNTS OF FEED USED PER COW PER DAY, AND PER UNIT OF PRODUCT, IN PASTURE AND WINTER PERIODS, IN POUNDS

	Per cent of cows freshening from September to December, inclusive						All herds		All herds (pasture period) per 100 pounds of milk produced in pasture period
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent				
	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per cow per day in winter	Per 100 pounds of milk produced in winter period	
Concentrates	6.8	53.4	9.6	54.5	9.8	43.4	8.9	50.2	13.8
Silage	26 4	207.1	38.4	217.3	38.8	172.6	35.5	198.9	27.0
Other succulent feed	0.8	6.4	2.2	12.5	1.6	7.2	1.7	9.4	22.5
Dry forage	17.9	140.4	16.8	95.0	16 9	75.2	17.1	95.7	2 5
Days of pasture	.....	......	.....	......	.....	......	.....	.....	6.3
Acres of pasture	.....	......	.....	.....	.....	......	.....	......	0.13

The average amounts of feed per horse were: concentrates, 2911 pounds; hay and other dry forage, 5419 pounds; silage and other succulent feed, 66 pounds. The cost of feed and pasture per horse was $95.

Pasture

The average length of the pasture season was 160 days. The average date of turning out in the spring was the morning of May 14, and that of stabling in the fall was the night of October 20.

The average charge for the use of pasture was $6.40 per cow (table 24), in addition to $1.18 per cow for the pasture of meadows after the hay was removed. The total charge to cows for the use of pasture was $7.58 per cow, or 13 cents per 100 pounds of milk sold.

TABLE 24. PASTURE CHARGES ON 121 FARMS

	Number of animal units pastured	Charge for pasture	
		Total	Per animal unit
Cows	2,672	$17,592	$6.58
Heifers	534	3,942	7.38
Bulls	73	367	5.03
Horses	232	1,455	6.27
Colts	2	11	5.50
Sheep	31	72	2.32
Meadows pastured after hay was removed	1,616	$3,225	$2.00
Cabbage bait	16	$15	$0 94

On the 121 farms, 9016.5 acres, valued at $221,445, were devoted to pasture. The receipts from milk sold during the pasture season amounted to $133,295; the value of feed used by cows supplementary to pasture was $28,257; thus leaving a surplus of $105,038, which is $868 per farm, or $11.65 per acre, in addition to returns from growth of young cattle.

TABLE 25. BEDDING USED ON 121 FARMS

Kind of bedding	Cows		Heifers		Herd bulls		Horses	
	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:								
Oat straw	329.2	$2,146	81.4	$549	1	$7	147.4	$985
Old oat straw	8.5	63	......	......	......	......	2.8	15
Oat and barley straw	24.5	181	4.5	32	......	......	15	109
Oat, barley, and wheat straw	4	20	4	20	......	......	4	20
Oat, pea, and barley straw	5	50	......	......	......	......	1	10
Oat and wheat straw	7	35	1	5	......	......	2	10
Barley straw	36.5	250	6	44	......	......	10.5	71
Rye straw	8	80	......	......	......	......	......	......
Wheat straw	47.1	268	11	63	......	......	24.3	166
Buckwheat straw	12	85	1	8	......	......	2	18
Oat hay	4	40	1	10	......	......	3	30
Corn fodder	8	25	......	......	......	......	......	......
Corn stover	21.5	106	5	25	......	......	15.5	77
Sawdust	12	12	4	4	......	......	4	4
Total	527.3	$3,301	118.9	$760	1	$7	231.5	$1,515
Purchased:								
Oat straw	22 7	$103	7.6	$54	8	$56	10.5	$104
Sawdust	121.9	210	18 3	26	6	18	7 5	12
Shavings	39 5	43	14.5	15	......	..	5	6
Shavings and sawdust	5	10	5	10	......	..	.	.....
Total	189.1	$456	45 4	$105	14	$74	23	$122
Total bedding	716.4	$3,817	164.3	$865	15	$81	254.5	$1,637

Bedding

The charges for bedding amounted to $1.39 per cow, or 2 cents per 100 pounds of milk sold (table 25).

Labor

The charges for the direct human labor on cows averaged $36.79 per cow, or 64 cents per 100 pounds of milk sold. The horse labor in addition to hauling the milk amounted to $1.66 per cow, or 3 cents per 100 pounds of milk.

The average rates per hour were. human labor, 27 cents; horse labor, 16 cents. The variations in rates per hour asked by operators, and in the estimated rates paid for hired labor, are given in table 26:

TABLE 26. VARIATIONS IN RATES PER HOUR FOR OPERATORS AND HIRED MEN

Rate per hour (cents)	Operators		Hired men	
	Number of farms	Per cent	Number of farms	Per cent
6			1	1.3
8			1	1.3
9			2	2.5
10			2	2.5
12			3	3.8
13			1	1.3
14			2	2.5
15	4	3.3	3	3.8
16	1	0.8	3	3.8
17			3	3.8
18	1	0.8	5	6.3
19	5	4.2	2	2.5
20	3	2.5	13	16.4
21	2	1.7		
22	2	1.7	3	3.8
23			1	1.3
24	3	2.5	4	5.1
25	15	12.4	17	21.5
26	1	0.8		
27	1	0.8		
28	7	5.8	4	5.1
29	1	0.8		
30	26	21.5	8	10.1
32	1	0.8		
33	8	6.6	1	1.3
34	1	0.8		
35	14	11.6		
37	2	1.7		
40	11	9.1		
41	1	0.8		
42	1	0.8		
44	1	0.8		
45	1	0.8		
50	7	5.8		
60	1	0.8		
Total	121	100.0	79	100.0

TABLE 27. LABOR REQUIRED IN PASTURE AND WINTER PERIODS

	Hours in pasture period				Hours in winter period				Total hours			
	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value
Human labor for cows:												
Hauling milk	17,283	6.3	0.3	$ 4,575	24,409	8.9	0.2	$ 6,449	41,692	15.2	0.3	$11,024
Milking	77,025	28.0	1.1	20,757	107,272	39.0	1.1	28,902	184,297	67.0	1.1	49,659
Other human labor	27,533	10.0	0.4	7,413	163,513	59.5	1.6	44,066	191,046	69.5	1.1	51,479
Total	121,841	44.3	1.8	$32,745	295,194	107.4	2.9	$79,417	417,035	151.7	2.5	$112,162
Total except hauling milk	104,558	38.0	1.5	$28,170	270,785	98.5	2.7	$72,968	375,343	136.5	2.2	$101,138
Horse labor for cows:												
Hauling milk	21,617	7.9	0.3	$3,689	36,772	13.4	0.4	$6,281	58,389	21.3	0.3	$9,970
Other horse labor	3,176	1.2	0.1	423	30,956	11.2	0.3	4,129	34,132	12.4	0.2	4,552
Total	24,793	9.1	0.4	$4,112	67,728	24.6	0.7	$10,410	92,521	33.7	0.5	$14,522
Human labor for heifers	3,923	......	.....	$1,071	28,157	......	......	$7,708	32,080	......	....	$8,779
Horse labor for heifers	....	......	.....	... .	1,806	......	.....	$300	1,806	.. ...	....	$300

An average of 152 hours per cow, or 2.5 hours per 100 pounds of milk produced, was required on these farms (table 27). Of the 152 hours, 15 were spent in hauling milk, 67 in milking, and 70 in other labor taking care of cows. The average time spent in horse labor was 34 hours per cow, or 0.5 hour per 100 pounds of milk produced.

Hauling milk

Of the total farms delivering milk, 93 hauled their own milk, 8 hired their milk hauled, and 20 both hauled and hired. The charges for hauling the milk amounted to $8.96 per cow, or 15 cents per 100 pounds of milk sold. The charges for hauling and delivering are given in table 28:

TABLE 28. CHARGES FOR HAULING AND DELIVERY TO THE MILK STATION, 158,261 HUNDREDWEIGHT OF MILK

	Pasture period	Winter period	Total
Human labor:			
Number of farms	110	113	114
Hours	17,283	24,409	41,692
Value	$4,575	$6,449	$11,024
Horse labor:			
Number of farms	95	111	112
Hours	21,617	36,772	58,389
Value	$3,689	$6,281	$9,970
Value of total human and horse labor	$8,264	$12,730	$20,994
Hauling hired:			
Number of farms	......	......	28
Cash paid	......	......	$1,687
Use of automobiles and trucks:			
Number of farms	......	......	23
Value	......	......	$1,962
Total charges for hauling milk	......	......	$24,643
Amount received for hauling milk	......	......	$15
Total net cost of hauling milk	......	......	$24,628
Cost per 100 pounds of hauling milk	......	......	$0.15

Use of buildings

The average charge for the use of buildings was $7.32 per cow, or 13 cents per 100 pounds of milk sold. The data are given in table 29:

TABLE 29. CHARGES FOR USE OF BUILDINGS ON 121 FARMS

Value of barns and other buildings used for dairy cattle	$268,848
Interest at 5 per cent	$13,443
Taxes	5,115
Insurance	1,646
Repairs	5,412
Total	$25,616

TABLE 29 (*concluded*)

Charged to:	
Cows	$20,122
Heifers	4,535
Herd bulls	959
Total	$25,616

Of the 121 farmers, 102 had barns so arranged that the cows faced outward and 12 had barns so arranged that the cows faced inward, and 7 had one row of cows. Of the total, 99 drove thru for manure, and 4 had litter carriers.

Fifty-five farms had swing stanchions, 66 had straight stanchions. Of the floors, 93 were concrete and 22 were wood; and 6 of the farms had both concrete and wood floors. Forty-eight of the farmers had water buckets in the barn, 39 watered in yard tubs, 7 watered their cows in barn troughs, and the remainder used creeks or springs.

Use of equipment

The charge for use of equipment was $2.57 per cow, or 4 cents per 100 pounds of milk sold. The average value of equipment used was $299 per farm. The interest, repairs, purchases of new equipment, and depreciation on equipment, amounted to $68 per farm, or 23 per cent of the value of the equipment.

The following makes of milking machines were found on the 121 farms during the season of 1921: machines purchased in 1909, Hinman 1; in 1912, Hinman 1; in 1914, Hinman 2, Sharples 1; in 1915, Empire 1; in 1916, Hinman 1, Empire 4, Sharples 3; in 1917, Hinman 2, Empire 6, Sharples 5, Universal 1, Uebler 1, Perfection 2; in 1918, Empire 3, Sharples 1, Uebler 1, Perfection 3, Victor 1; in 1919, Hinman 2, Empire 10, Universal 1, Uebler 1, Pine Tree 3, Perfection 2; in 1920, Empire 7, Universal 2, Uebler 1, Pine Tree 1, Perfection 2; in 1921, Hinman 1, Pine Tree 1; in 1922, Sharples 1, Uebler 1, Pine Tree 1; a total of 77 machines. Of these, 6 had not been used during the year. The remaining 71 had been used as follows: January, 56; February, 56; March, 59; April, 63; May, 63; June, 62; July, 58; August, 58; September, 59; October, 59; November, 55; December, 55; a total of 703 months out of 852 months, or 83 per cent of the time.

Interest

The interest charge on cows averaged $6.77 per cow, or 12 cents per 100 pounds of milk sold.

Depreciation on cows

The average value of grade cows was $85, and of purebred cows $176; the average for both grade and purebred cows was $113. The depreciation on cows was $2.70 per cow, or 5 cents per 100 pounds of milk sold. The depreciation is exceptionally small in this section because of the large proportion of purebreds. The averages of the estimates as to the decrease in market value of cows during the year were, for grades, $20.42 per head, and for purebreds, $27.86 per head.

The number of cows that were sold, that were eaten on farms, and that died, was 22.2 for each 100 cows. Of the cows replaced, 66 per cent were raised at home, and 34 per cent were purchased.

Bull service

The average cost of keeping 132 herd bulls was $89.81 per cattle unit, or $4.10 per cow kept. There was a net depreciation on bulls of $7.60 per cattle unit. This was due chiefly to the use of purebred sires of high value, the average value of bulls being $190 per head. The charge for bull service was $4.10 per cow, or 7 cents per 100 pounds of milk sold. (Table 30.)

TABLE 30. COST OF BULL SERVICE ON 121 FARMS

	Total		Per cattle unit	
	Amount	Value	Amount	Value
Costs:				
Concentrates	886 cwt.	$1,595	714 lbs.	$12 85
Succulent feed	199.3 tons	1,124	3,212 lbs.	9.06
Dry forage	215 tons	3,326	3,465 lbs.	26.80
Whole milk	14,009 lbs.	298	113 lbs.	2.40
Pasture	....	367	....	2 96
Bedding	15 tons	81	242 lbs.	0.65
Interest	....	1,378	....	11.11
Use of buildings	....	959	....	7.73
Depreciation	....	943	....	7.60
All other costs	....	3,083	....	24.84
Total	.. ..	$13,154	....	$106.00
Returns:				
Manure	928 tons	$1,845	....	$14.87
Service	.. ..	164	....	1.32
Total	.. ..	$2,009	... .	$16.19
Cost of keeping own herd bulls		$11,145	....	$89.81
Service hired		$117	....	.. .
Net cost of bull service		$11,262	....	.
Net cost per cow		$4.10	....	... .
Number of herd bulls		131.6	....	......
Cattle units of herd bulls		124.1	....	......

Miscellaneous charges

Miscellaneous expenses in milk production are given in table 31:

TABLE 31. MISCELLANEOUS EXPENSES FOR COWS, 121 FARMS

Item	Charge
Advertising	$ 204
Salt	1,225
Grinding feed	441
Electric lights and carbide	489
Insurance	1,071

TABLE 31 (*concluded*)

Item	Charge
Coal, oil, gasoline	$ 2,652
Farm share of upkeep and operation of automobile	1,356
Freight and express	1
Ice, and sawdust for ice	806
League deductions	90
Cow-tester, acid	490
Spray materials	219
Water (city)	16
Stamps and stationery	35
Telephone	412
Veterinary fees	2,114
Other farm expense	678
Total	$12,299
Total per cow	$4 47
Total per 100 pounds of milk sold wholesale	$0.08

RETURNS

Milk and milk products

The returns from milk sold are given in tables 15 and 16, pages 19 and 20. Data for milk and its products used on the farm are given in table 32:

TABLE 32. RETURNS FROM MILK PRODUCTS SOLD AND MILK AND ITS PRODUCTS USED ON THE FARM, 2749 COWS

	Number of farms	Number of pounds of product	Total value
Milk products sold:			
Butter	2	137	$ 55
Milk sold retail	2	3,879	139
Milk used:			
Operators' families	121	404,896	$7,874
Hired men's families	28	53,014	1,037
Landlords' families	2	2,355	53
Chickens	1	130	3
Total milk used	121	460,395	$8,967
Milk products used:			
Butter, family use	8	806	326
Skimmilk, chickens	1	1,200	3
Total milk and its products used, except that fed to cattle	121	462,401	$9,296
Milk fed:			
Heifers	103	541,955	$12,178
Veals	34	106,191	2,360
Bull calves to be sold	8	33,518	681
Bull calves to be raised	12	14,009	298
Total milk fed to cattle	108	695,673	$15,517

TABLE 32 (*concluded*)

	Number of farms	Number of pounds of product	Total value
Milk products fed:			
Skimmilk, heifers	6	10,630	$28
Total milk and its products fed to cattle	108	706,303	$15,545
Equivalent, in pounds of milk, of milk and its products used	121	1,168,704	....
Pounds of fat in milk retailed, milk products sold, and milk and its products used	....	39,411	... .

The average amount of milk used by operators' families was 3346 pounds per family; for farms using milk for heifers, the average was 5262 pounds per farm. Of the total milk produced, 93.1 per cent was sold and 6.9 per cent was used on the farm. The average production per cow was 6184 pounds of milk, containing 207 pounds of butterfat.

The production per cow in the stabling period averaged 3656 pounds, or 17.8 pounds per cow per day. In the pasture period the production was 2528 pounds of milk per cow, or 15.8 pounds per cow per day.

Calves born during the year

A total of 2691 calves were born during the year, of which 123, or 4.6 per cent, were born dead (table 33). Of the cows on hand at the end of the year, 50, or 1.8 per cent, would not breed, and 158, or 5.6 per cent, had unsound quarters. The average weight of cows was 940 pounds,

TABLE 33. NUMBER OF CALVES BORN DURING THE YEAR, AND THEIR VALUE AT BIRTH

	Number of farms	Number of calves	Per cent	Value	Value of each at birth
Heifers to be raised or sold:					
Purebred	56	347	13.6	$9,699	$27.95
Grade	64	261	10.2	1,023	3.92
Bulls to be kept:					
Purebred	9	12	0.5	355	29.58
Grade	7	8	0.3	23	2.88
Bulls sold or to be sold:					
Purebred	9	29	1.1	645	22.24
Grade	2	3	0.1	7	2.33
Calves vealed or to be vealed	117	1,770	69.1	4,653	2.63
Calves deaconed	25	130	5.1	... .	....
Deacon hides	13	(76)	......	67	0.88
Total calves born alive*	121	2,560	100.0	$16,472	$6.43

* The total number of calves exceeds the number of cows calving, by one, because of twins.

TABLE 33 (*concluded*)

	Number of farms	Number of calves	Per cent	Value	Value of each at birth
Live calves per 100 cows...	...	93	...	...	...
Calves born dead......	55	123	...	...	...
Dead calf hides......	8	(16)	...	$18	...
Total credited to cows....	...	...	...	$16,490	...
Cows that aborted..	3	8	...	...	...
Cows that would not breed.....	27	50	...	...	...
Cows with unsound quarters ...	83	158	...	...	...

and the average number of weeks during which they were dry was 8.2. The value at birth of grade heifers was $3.92 each; of purebred heifers, $27.95; of calves for vealing, $2.63; and of all live calves born during the year, $6.43. Of the total live calves born during the year, 23.8 per cent were heifers raised and 2 per cent were bulls raised; 74.2 per cent were vealed or deaconed.

The returns from calves sold amounted to $6 per cow, or 10 cents per 100 pounds of milk sold.

Manure

The average value of manure was $1.97 per ton at the barnyard. It was credited at this value on all farms. The amount recovered from cows averaged 7.4 tons, valued at $14.56, per cow; this was a credit for manure averaging 25 cents per 100 pounds of milk sold. The data are given in table 34:

TABLE 34. MANURE RECOVERED FROM CATTLE AND HORSES

	All stock	Cows	Heifers	Herd bulls	Bull calves to be sold	Horses
Manure recovered (tons) ..	29,682	20,320	4,720	928	30	3,684
Value at $1.97 per ton at the barnyard...............	$58,480	$40,032	$9,289	$1,845	$60	$7,254

Miscellaneous returns

The various miscellaneous returns credited to cows averaged 20 cents per cow.

SUMMARY OF COSTS AND RETURNS

The costs and returns for cows, expressed per cow and per 100 pounds of milk, are given in table 35. The net cow cost of producing milk was $2.56 per 100 pounds. The herd cost, $2.63, was 7 cents higher, due to a loss on heifers. The cost per pound of fat was 76 cents.

With concentrates at $37.53, silage at $5.61, and dry forage at $14.96, per ton, and labor at 27 cents per hour, the average loss was $26.70 per

cow, in addition to an average decrease in the market value of cows of \$20.42 per head for grades and \$27.86 for purebreds. The loss per 100 pounds of milk sold was 46 cents. Grain was cheap, the charge for silage probably was less than its actual cost of production, the price of hay was not high, and certainly 27 cents an hour was not an unreasonable rate of wages for farm work. When, with the conditions as stated and the good production of 6184 pounds of milk per cow, so large a loss resulted from milk production, something other than inefficient operations on the farms must have been the cause. The price was too low.

TABLE 35. SUMMARY OF COSTS AND RETURNS, 2749 COWS

	Per cow	Per 100 pounds of milk sold wholesale
Costs:		
Concentrates	\$41.85	\$0.73
Succulent feed	24.47	0.42
Dry forage	26.48	0.46
Pasture	7.58	0.13
Bedding	1.39	0.02
Human labor	36 79	0.64
Horse labor	1.66	0.03
Hauling milk	8.96	0.15
Use of buildings	7.32	0.13
Use of equipment	2.57	0.04
Interest on cows	6.77	0.12
Depreciation on cows (net)	2.70	0.05
Bull service	4.10	0.07
Miscellaneous	4.47	0.08
Total costs	\$177.11	\$3.07
Returns:		
Milk sold wholesale:		
Cash	\$113.25	\$1.97
Certificates of indebtedness	7.29	0.13
Milk products sold, and milk retailed	0.07	....
Milk and milk products used, except that fed to cattle	3.38	0.06
Milk and milk products fed to cattle	5.66	0.10
Calves and calf hides	6.00	0.10
Manure	14.56	0.25
Miscellaneous	0.20	....
Total returns	\$150.41	\$2.61
Loss	\$26.70	\$0.46
Cow cost of producing milk	\$147.24	\$2.56
Herd cost of producing milk	....	\$2.63
Cow cost per pound of butterfat	....	\$0.76

The reason for the low price of milk is probably the same as that for the low price of any product, that is, abundance. When scarcity develops, the price will rise.

e returns per hour of labor above all other costs in the production of on these farms, was 9.3 cents. The total income per cow was $150.41, he costs were $177.11.

e variations in the cost of producing milk are shown in table 42 44). The cost of production on each farm is shown in table 55 s 69 to 72).

COST OF RAISING HEIFERS

e average age of heifers at the time of the first freshening was 27.9 hs, and consequently their cost up to two years of age does not sent the cost up to the time of freshening. About one-sixth should dded, making the cost at the time of freshening approximately .

ie value of the heifers at the time of freshening averaged $67.80 for es, $162.35 for purebreds, and $111.62 for all of the 533 heifers. The ber of heifers freshening for the first time at each age is given in 36:

LE 36. AGE OF HEIFERS FRESHENING FOR THE FIRST TIME, AND THEIR VALUE

Age (months)	Number of heifers	Value
	1	$ 50
	1	50
	2	151
	3	200
	9	525
	2	150
	143	16,611
	28	3,720
	39	4,805
	40	4,425
	48	8,000
	147	14,695
	7	570
	9	1,025
	4	650
	41	3,300
	5	325
	4	240
Total	533	$59,492

The average cost of raising heifers up to two years of age was $127 per ad (table 37). In herds with more spring-fresh cows, it was $123 per ad; and in herds with largely fall-fresh cows, it was $128 per head.

The average amount of feed used per cattle unit of heifers was 908 unds of whole milk, 95 pounds of skimmilk, 1149 pounds of concentrates, 546 pounds of silage and other succulent feed, and 3214 pounds of hay d other dry forage. The human labor averaged 54 hours per cattle nit.

TABLE 37. COST OF RAISING HEIFERS

	Per cent of cows freshening from September to December, inclusive						All herds		
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent		Total		Amount per cattle unit
	Amount	Value	Amount*	Value	Amount*	Value	Amount*	Value	
Costs:									
Whole milk	120,543 pounds	$2,152	271,414	$6,423	149,998	$3,603	541,955	$12,178	908 pounds
Skimmilk:									
Farm	1,250 pounds	2	5,275	15	4,105	11	10,630	28	18 pounds
Purchased			3,600	10	42,200	199	45,800	209	77 pounds
Grain	1,107 cwt.	2,038	3,924	7,062	1,826	3,335	6,857	12,435	1,149 pounds
Silage	209.3 tons	1,175	864.9	4,852	508.5	2,851	1,582.7	8,878	5,302 pounds
Other succulent feed	1 ton	15	12.2	98			13.2	113	44 pounds
Hay	186.6 tons	3,092	449.2	6,771	270.5	4,404	906.3	14,267	3,036 pounds
Other dry forage	4.5 tons	28	36	119	12.5	46	53	193	178 pounds
Pasture		709		2,182		1,051		3,942	
Bedding	18 tons	98	83.7	500	62.6	267	164.3	865	550 pounds
Human labor	5,869 hours	1,596	16,652	4,545	9,559	2,638	32,080	8,779	54 hours
Horse labor	358 hours	55	1,163	202	285	43	1,806	300	3 hours
Use of buildings		682		2,633		1,220		4,535	
Use of equipment		239		662		330		1,231	
Interest on stock		711		2,770		1,560		5,041	
Miscellaneous		52		452		147		651	
Total costs		$12,644		$39,296		$21,705		$73,645	
Returns:									
Manure	724 tons	$1,424	2,615	$ 5,145	1,381	$ 2,720	4,720	$ 9,289	7.9 tons
Appreciation		7,699		29,680		15,574		52,953	
Total returns		$9,123		$34,825		$18,294		$62,242	
Difference (loss)		$3,521		$4,471		$3,411		$11,403	
Value at birth, plus purchases, less sales and hides and those eaten		$2,313		$6,714		$2,728		$11,755	
Cost of raising a heifer to two years of age:									
Total		$13,533		$40,865		$21,713		$76,111	
Per cattle unit		$122.92		$128.55		$128.48		$127.49	
Number of cattle units	110.1		317.9		169		597		

* The same unit of quantity is used in this column as is used in the first column for amounts.

FALL OR SPRING FRESHENING

The records were arranged in the same manner, according to the proportion of the cows freshening from September to December, inclusive, as for farms reported in the preceding bulletins of this series. An average of 40.8 per cent of all of the cows freshened from September to December, inclusive; but in the 30 summer dairies 10.5 per cent, and in the 34 largely winter dairies 67.8 per cent, of the total number freshened during these months. The data are given in table 38:

TABLE 38. COWS FRESHENING BY MONTHS

	All herds		Per cent of cows freshening from September to December, inclusive					
			Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1921:								
May	105	7.2	79	11.9	91	7.5	25	3.1
June	70	2.6	19	2.9	39	3.2	12	1.5
July	54	2.0	13	1.9	30	2.5	11	1.4
August	94	3.5	12	1.8	46	3.8	36	4.4
September	283	10.5	10	1.5	116	9.5	157	19.4
October	318	11.8	15	2.2	126	10.4	177	21.8
November	267	10.0	16	2.4	114	9.4	137	16.9
December	229	8.5	29	4.4	121	10.0	79	9.7
1922								
January	229	8.5	70	10.5	106	8.7	53	6.5
February	221	8.2	97	14.6	99	8.2	25	3.1
March	344	12.8	148	22.3	147	12.1	49	6.0
April	386	14.4	157	23.6	179	14.7	50	6.2
Total	2,690	100.0	665	100.0	1,214	100.0	811	100.0

TABLE 39. RELATION OF SEASON OF FRESHENING TO VARIOUS FACTORS

	Per cent of cows freshening from September to December, inclusive			
	Less than 25 per cent	From 25 to 50 per cent	More than 50 per cent	All herds
Number of farms	30	57	34	121
Number of cows	679.7	1,259.5	809.5	2,748.7
Cows per farm	22.7	22.1	23.8	22.7
Average capital per farm	$14,207	$17,116	$17,797	$16,586
Average labor income per farm	$60	$180	$785	$321
Pounds of milk produced per farm	117,957	136,263	167,443	140,486
Pounds of milk produced per cow	5,204	6,164	7,037	6,184
Weight of cows (pounds)	925	925	979	940
Per cent of milk sold from November to April	42.5	51.3	59.5	52.3
Butterfat test of milk (per cent)	3.44	3.34	3.31	3.35
Per cent of cows freshening from September to December, inclusive	10.5	39.3	67.8	40.8
Cost of milk per 100 pounds	$2.64	$2.69	$2.33	$2.56
Price received per 100 pounds	$2.09	$2.11	$2.08	$2.10

The average number of cows was 22.7 in the summer dairies, and 23.8, only one cow more, in the winter dairies. On the farms having a larger proportion of cows freshening in the fall months than in the spring, the average capital per farm was $3590 greater, the production per cow was 1833 pounds greater, the weight of cows was 54 pounds more, the cost of milk was 31 cents per 100 pounds less, and the average labor income was $725 more. (Table 39.)

The ages of cows in the three groups of herds are shown in table 40. Of all the cows, 52.5 per cent were five years old or less, and 11.1 per cent were more than eight years old. Since a larger proportion of the cattle in this region are purebred than in the other regions studied, there are more younger cows here than in the other regions.

TABLE 40. AGES OF 2835 COWS ON HAND APRIL 30, 1922

Age (years)	Per cent of cows freshening from September to December, inclusive						All herds	
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
2–3	91	12.9	221	17.1	140	16.6	452	15.9
3–4	103	14.7	222	17 2	142	16.9	467	16 5
4–5	167	23.8	233	18.0	169	20.1	569	20.1
5–6	116	16.5	208	16.1	151	17.9	475	16.7
6–7	92	13.1	144	11.2	94	11.2	330	11.6
7–8	66	9.4	96	7.4	67	8.0	229	8.1
8–9	34	4.9	66	5.1	39	4.6	139	4.9
9–10	15	2.1	50	3 9	22	2.6	87	3.1
More than 10	18	2.6	51	4.0	18	2.1	87	3.1
Total	702	100.0	1,291	100.0	842	100.0	2,835	100.0

Variations in the labor incomes on these farms, and in the cost of producing milk on them, are shown in tables 41 and 42. Of the 121 farms, 30 made labor incomes of more than $1000, 45 failed to make interest, and 46 made labor incomes of from $1 to $1000. Of these same farms, 54 produced milk at less than $2.50 per 100 pounds and on 15 the cost was more than $3.50 per 100 pounds.

TABLE 41. VARIATIONS IN LABOR INCOMES ON 121 FARMS

Per cent of cows freshening from September to December, inclusive	Number of farms making labor incomes as designated				
	Minus $500 or more	Minus $499 to 0	Plus $1 to plus $500	Plus $501 to $1000	More than $1000
Less than 25 per cent	10	3	8	5	4
From 25 to 50 per cent	15	10	7	10	15
More than 50 per cent	6	1	8	8	11
All herds	31	14	23	23	30

TABLE 42. VARIATIONS IN COST OF PRODUCING MILK ON 121 FARMS

Per cent of cows freshening from September to December, inclusive	Cow cost per 100 pounds sold wholesale: Less than $2.50	$2.50 to $3.00	$3.01 to $3.50	$3.51 to $4.00	$4.01 to $4.50	More than $4.50
Less than 25 per cent	10	11	6	1	1	1
From 25 to 50 per cent	25	12	8	8	4	0
More than 50 per cent	19	10	5	0	0	0
All herds	54	33	19	9	5	1

The average returns per hour of labor after all other costs were met were 6.4 cents in the summer dairies and 16.9 cents, or 10.5 cents higher, in the winter dairies (table 43).

TABLE 43. COSTS AND RETURNS FOR THE THREE SEASONAL GROUPS

	Per cent of cows freshening from September to December, inclusive					
	Less than 25 per cent		From 25 to 50 per cent		More than 50 per cent	
	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale	Per cow	Per 100 pounds of milk sold wholesale
Costs:						
Concentrates	$31.76	$0.66	$45.04	$0.79	$45.34	$0.68
Succulent feed	16.94	0.35	27.38	0.48	26.29	0.40
Dry forage	27.99	0.59	25.34	0.44	26.98	0.41
Pasture	7.59	0.16	7.76	0.14	7.27	0.11
Bedding	1.01	0.02	1.59	0.03	1.40	0.02
Human labor	32.07	0.67	37.70	0.66	39.35	0.59
Horse labor	1.33	0.03	1.62	0.03	1.98	0.03
Hauling milk	8.94	0.18	9.46	0.16	8.19	0.12
Use of buildings	6.13	0.13	8.06	0.14	7.17	0.11
Use of equipment	1.80	0.04	2.63	0.05	3.11	0.05
Interest on cows	5.78	0.12	7.25	0 13	6 87	0.10
Depreciation on cows (net)	2.00	0.04	1.87	0.03	4.59	0.07
Bull service	2.95	0.06	5.12	0.09	3.48	0.05
Miscellaneous	4.43	0.09	4.84	0.08	3.94	0.06
Total costs	$150.72	$3.14	$185.66	$3.25	$185.96	$2 80
Returns:						
Milk sold wholesale	$94.43	$1.97	$113.64	$1.99	$128.45	$1.94
Certificates of indebtedness	5.84	0.12	6.76	0.12	9.33	0.14
Milk products sold, and milk retailed	0.17	....	0.02	....	0.06	....
Milk and milk products used, except that fed to cattle	3.12	0.07	3.29	0.06	3.74	0.06
Milk and milk products fed to cattle	4.40	0.09	6.65	0.11	5.18	0.08
Calves and calf hides	3.95	0.08	6.76	0.12	6.54	0.10
Manure	12.21	0.26	15.27	0.27	15.44	0.23
Miscellaneous	0.06	......	0.19	... .	0.33	....
Total returns	$124.18	$2.59	$152 58	$2.67	$169.07	$2.55
Loss	$26.54	$0.55	$33.08	$0.58	$16.89	$0.25
Returns per hour of human labor above all other costs	......	$0.064	......	$0.059	......	$0 169

ORGANIZATION OF THE BUSINESS

The system of dairying here reported is Grade B milk with ordinary roughage, with cultivated cash crops, and with 31 per cent of the cows purebred. Of the sales of crops, 47.4 per cent was from cabbage, 30.3 per cent was from market peas, 8.4 per cent was from potatoes, and 5.2 per cent was from hay.

CASH CROPS

Cabbage

In connection with the management of farms, the following points concerning the marketing of cabbage are important:

1. White Danish cabbage normally doubles in price to the farmer, and doubles in price in New York City, from October to March.
2. In dry years, the highest price is reached in January; in years of average rainfall, in February; and in wet years, in March. In dry years, it pays to sell storage cabbage earlier than in wet years.
3. In the chief cabbage-producing sections, the production, and therefore the price, of Danish cabbage is determined primarily by the rainfall.
4. Since the largest proportion of the Danish cabbage is grown in western New York, the rainfall in that area largely determines the price that farmers receive for cabbage.

The purple, or red, Danish cabbage is being tried in the region studied. Several farms had a small patch of this strain, and the price was about $4 a ton higher than for white Danish cabbage.

Market peas

The vicinities of Sherburne, Earlville, Hamilton, and Hubbardsville constitute the most intensive center of market-pea production in New York, outside of the Erie County area. Peas are a highly speculative crop because of the variation in production and in quality, and because of their extreme perishability.

The average area in market peas per farm for 1921 was 1.1 acres for all farms, and 3.4 acres for the farms growing the crop. Most farmers drill the seed in rows about 3 feet apart, and cultivate until the vines fall over between the rows. Rarely, a farmer will use a grain drill with all cups open and do no cultivating. Peas are usually preceded in the rotation by a tilled crop. Beginning in April, successive plantings are made; then the harvesting can be accomplished more easily.

For fertilizer, 2–8–4, 2–8–10, and acid phosphate are the most commonly used; these are applied when the seed is planted. The average application on farms using fertilizer was 307 pounds per acre, as shown in table 49 (page 60). Market-pea crops are sometimes followed by a seeding of alfalfa the same year, after clearing away the vines and dragging the land; but more usually they are followed by a grain crop the next year. Some growers burn the vines, and some harvest them for cow feed. If cabbage and potatoes are grown, the pressure of work often results in the vines being wasted.

The average yield of peas on the farms studied, for the 1921 season, was 146 bushels per acre. The proportion of early and late varieties

should always be known when considering yield per acre; the yield of early peas is usually less than that of late varieties.

Recent information on the cost of producing peas is not available. In 1915, the costs on some farms in Madison and Otsego Counties indicated that about 46 per cent of the cost was for picking, and the remainder was for other growing and marketing costs. The rate for picking that year was 20 cents a bushel; it was 40 cents in 1922. The problems and the cost of harvesting the pea crops are as great as all the other phases of the pea-growers' perplexities.

The crop is picked, for about 40 cents a bushel, by men, women, and children from the neighborhood or brought from distant cities. Italian families are now imported, chiefly from Utica, and are housed in barns or old buildings.

The same rate for picking does not indicate that the same wages can be earned in all fields. Picking in weedy, broadcast, small, or steep fields is slower. Growers who keep their fields clean pay with protest the bushel rate offered by those with weedy or broadcast fields. They say that with the better yield and easier picking, the harvesting charge is too high for the time required.

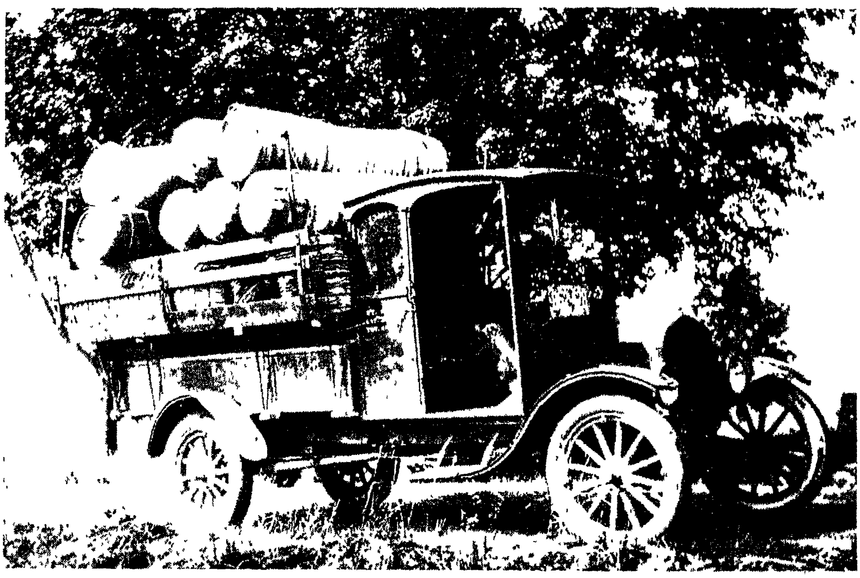


FIGURE 1. BUSHEL BASKETS FOR SHIPPING MARKET PEAS
The baskets are made at Hamilton, the center of the pea-growing region, and are hauled to the farms by the growers

Peas are shipped in bushel baskets (figure 1), by express; in earlier years, bags were used. The crop is shipped to commission merchants whose usual fee is 10 per cent of the sales price. Some of the costs for the pea crop are shown in table 44:

TABLE 44. SOME OF THE EXPENSES FOR THE MARKET-PEA CROP, 138 ACRES, 20,101 BUSHELS SOLD, 1921

	Total	Per bushel
Commissions	$2,808	$0.14
Express	4,715	0.24
Fertilizer	851	0.04
Seed	1,995	0.10
Labor for picking	8,040	0.40
Baskets	2,973	0.15
Total	$21,382	$1.07
Interest and taxes on land		0.02
Approximate labor for growing and marketing:*		
40 man hours per acre, at 27 cents per hour		0 07
50 horse hours per acre, at 16 cents per hour		0.06
Total of above cost items		$1.22
Average price received per bushel		$1 85
Difference (= pay for all other charges, and gain)		$0.63

* A study of market peas in Madison and Otsego Counties, New York. By C. F. Saile, for the Department of Farm Management, New York State College of Agriculture. 1916.

The Delaware, Lackawanna & Western Railroad is now furnishing pre-cooled refrigerator cars to farmers who will club together and ship a carload of peas. The car can be placed the preceding night, be loaded the next day, leave in the evening, and arrive at the terminal market on the following afternoon. The expense for freight, including ice, is less than the express charges, and the peas arrive in better condition than when shipped in an uncooled express car.

Some peas are grown on the partnership plan. A retired farmer or a village man will furnish the seed and pay half of the fertilizer charges, hire the pickers, know where the crop will be sold, and arrange for the baskets. The farmer prepares the land, plants the crop, and cultivates it until the vines fall over. The charges for seed, baskets, picking, express, commission, and other expenses, are deducted from the gross returns, and the balance is divided equally between the farmer and the partner.

In 1921, the yield of peas was 146 bushels per acre and the average price was $1 85 per bushel The total for commissions, express, fertilizer, seed, labor for picking, and baskets, was $1.07 per bushel. The average value of the crop land was $55 per acre. Interest at 5 per cent, and taxes, amount to 2 cents per bushel. If 40 hours of labor per acre are required, at 27 cents per hour (the rate asked by the farmers for labor in milk production), man labor in growing the crop amounts to 7 cents per bushel. Horse labor, if 50 hours per acre are required at 16 cents an hour, amounts to 6 cents per bushel. The total of all of the charges specified is $1.22 a bushel. Other costs have not been included. The difference between the price received, $1.85, and the charges, $1.22, is 63 cents per bushel; this must pay for all other costs and the profit. Probably 50 cents per bushel, or about $70 an acre, would remain as gain. But the yield and the price were good this season.

In the Munnsville area, the average yield on 152.5 acres in 1921 was 114 bushels per acre and the average price per bushel was $2.15.[5] In 1922, however, the average yield on 151.5 acres was 81 bushels and the average price received was $1.57 per bushel. With this yield and price, very little profit is made in producing market peas.

The common market pea is comprised of varieties with either smooth or wrinkled seeds. The wrinkled varieties are not well adapted to early planting, because they are more susceptible to decay and to frost injury.

The growing of peas for the large city markets is confined to areas with soil and climatic conditions favorable for their production. The sequence and the points of origin of the supply of market peas for New York City are approximately as follows: November to March, from Florida; March 15 to April, from South Carolina; during May, from North Carolina; in May and part of June, from Virginia, Maryland, New Jersey, and Long Island; during June and the first part of July, from Erie County, New York; and from July until the last of September, from Madison and Chenango Counties, New York.

Peas, being a leguminous crop, naturally do best on soils abounding in lime. A calcareous soil of rather heavy texture is found in many parts of Madison County. This type of soil seems to be particularly well adapted to the production of peas for the market. Many sections of the State are sufficiently well adapted for the successful production of early peas, but this crop would compete with the pea production farther south, and apparently the returns are not enough to justify the production of early varieties. The southern part of Madison County, situated in a very narrow valley, rises at an elevation of more than 1000 feet above sea level. The rainfall in this section is plentiful, and the shipping facilities to the metropolitan district are adapted to quick and efficient transportation. Probably the most important reason for the development of the pea-growing industry in this vicinity is that the limestone soil lies at a high elevation. There are many other sections of the State with as good a rainfall as southern Madison County has, and some other sections with equally good transportation facilities; but there are few regions that have these two necessary conditions combined with a limestone soil of heavy texture at a high elevation, where the growing-season temperature, especially during the nights, is relatively low. Limestone soil, a cool season, adequate rainfall, and good shipping facilities, are necessary for the profitable production of this crop.

In the pea-growing section there are a few growers who regularly have a large acreage. Most of the peas, however, are grown on small acreages as a cash crop on dairy farms. Those who grow large quantities of peas adhere to about the same acreage from year to year, while other growers often vary the acreage from one year to another, according to the favorableness of the crop during the preceding year. The price in any particular year depends on the production, which in turn is dependent on the acreage planted, the weather conditions, the length of the growing season, and injury from disease and insects. There are no reliable reports of production prior to 1921. In the United States, the acreage of green peas for the table was 9990 acres in 1921, 13,790 acres in 1922, 17,380 acres in 1923, and 21,460 acres in 1924; of which New York grew 1500 acres in

[5] Bulletin 438 of this experiment station, page 14.

1921, 1650 acres in 1922, 1800 acres in 1923, and 4870 acres in 1924.[6] The total production of green peas for the table was 716,000 one-bushel hampers in 1921, 1,093,000 one bushel hampers in 1922, 1,262,000 one-bushel hampers in 1923, and 1,608,000 one-bushel hampers in 1924. New York grows from one-eighth to one-fourth of all the green peas for the table produced in the United States.

Since Madison County has decided advantages in the production of late peas, about 90 per cent of the varieties grown are late peas and 10 per cent are early-maturing peas. The dark-podded Telephone peas bring the highest price and are the most largely planted. The Thomas Laxton and Gradus are next in importance. The seed is grown in the Rocky Mountain States, where, the climate being dry, the seed can be properly cured. Sometimes Telephone-pea seed is of the light-pod variety. Since the dark-podded Telephone peas bring the highest prices, this description of the varieties should be indicated when seed is purchased.

In a study of the production of market peas[7] on 106 farms in Madison County, it was found that 15 farmers harrowed the ground three times, 79 harrowed it four times, and 12 harrowed it five times, in fitting it for peas. The pea crop usually follows some other cultivated crop in rotation, but occasionally it is grown on sod. Peas have been grown for so many years that inoculation of the seed does not seem to be necessary for good results.

Of the 86 farmers reporting to Mr. Townsend, 22 farmers used $1\frac{3}{4}$ bushels of seed per acre, 51 used 2 bushels of seed per acre, and 13 used $2\frac{1}{4}$ bushels of seed per acre. The yields of peas averaged 99 bushels, 131 bushels, and 132 bushels, per acre, respectively. Of these same 86 farmers, 61 cultivated the crop five times, and 25 cultivated it three times or less. Cultivation should be shallow because the root development is near the surface of the ground.

A factory at Hamilton manufactures the bushel baskets used for shipping peas to the city. These baskets are distributed to the pickers in the field, prior to the picking. The vines are pulled, and are either cured for hay or burned. The picker can harvest from 8 to 10 bushels a day. When there is a large gang of pickers, the farmer, or some one in his employ, acts as field boss, issuing tally cards to the pickers as they bring in their baskets, and attending to filling the baskets and fastening the covers. The peas are then hauled to the railroad station for shipment by express to the city market. Most of the peas produced in this area go to New York; at times when the New York City market is well supplied, shipments are made to Pittsburgh, Boston, and other near-by eastern cities.

Cooperative marketing has been tried for the past few years in this region.[8] A brand name, "Harvest Moon," was chosen for the choicest pick of market peas by the local association which acts as a part of the New York Canning Crops Cooperative Association, Inc. These peas became known as "Red Label Peas from Madison County," and brought the best price the market offered.

The five-years (1910–1914) daily average price of state peas per basket in New York City from June 26 to September 19, is shown in figure 2 and table 45. Prices during the last week of June and the first week of

[6] U. S. Agr. Dept., Crops and markets 1, Supp. 12:418. December, 1924.
[7] A study by L. H. Townsend for the Department of Vegetable Gardening, New York State College of Agriculture.
[8] The Madison County farm and home bureau news, 7:1. April-May, 1923.

TABLE 45. AVERAGE WHOLESALE PRICES IN NEW YORK CITY FOR STATE PEAS, PER BASKET (BUSHEL)*

	5-years average, 1910–1914	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
June 25	$1.28	$1.06	$0.82	†	S	$1.44	†	$1.12	†	S	†	$2.62	†	$2.38	$2.88	S	†	†
26	1.49	1.22	0.68	S	$1.69	1.40	$1.50	1.38	†	†	†	2.62	$2.38	2.00	S	†	$3.62	†
27	1.46	1.46	S	†	1.69	1.40	1.38	1.38	S	†	†	2.00	2.75	S	2.62	†	3.25	†
28	1.30	S	0.58	†	1.38	1.40	1.12	S	†	†	†	2.00	2.75	2.00	3.00	†	3.12	†
29	1.34	1.63	0.52	†	1.31	1.46	S	1.25	†	†	†	2.00	S	2.00	2.75	†	3.25	S
30	1.25	1.63	0.50	†	1.13	S	1.12	1.50	†	$1.50	†	S	2.50	2.00	2.88	$3.00	2.75	†
Average	$1.35	$1.40	$0.62	...	$1.44	$1.42	$1.28	$1.33	.	$1.50		$2.25	$2.60	$2.08	$2.83	$3.00	$3.20	.
July 1	$1.20	$1.56	$0.44	$0.94	$1.25	$1.43	$1.12	$1.25	$1.00	$1.50	S	$1.88	$2.50	$1.50	$2.25	$2.75	S	$2.25
2	1.25	1.63	0.62	0.81	S	1.56	1.25	1.38	1.00	S	†	2.00	2.25	1.38	1.50	S	$2.88	2.25
3	1.48	1.56	0.62	S	1.44	1.72	1.25	1.50	0.68	1.50	†	2.25	1.75	1.00	S	2.12	2.25	1.50
4	H	H	S	H	H	H	H	H	S	H	H	H	H	S	H	H	H	H
5	1.36	S	H	0.62	1.50	1.94	1.38	S	H	1.75	†	2.00	1.75	H	2.00	2.00	1.75	1.75
6	1.45	1.22	0.86	0.69	1.50	2.12	S	1.50	0.58	1.62	†	2.00	S	1.00	2.25	2.12	1.62	S
7	1.34	1.38	1.01	0.88	1.34	S	1.38	1.75	0.68	1.75	†	S	3.00	1.00	2.25	2.00	1.25	1.62
8	1.34	1.38	0.98	0.75	1.18	1.62	1.38	1.75	0.58	1.75	S	2.00	3.50	1.38	2.25	2.00	S	1.50
9	1.36	1.31	1.01	0.75	S	1.56	1.31	1.81	0.62	S	$1.50	2.00	3.12	1.38	2.25	S	1.50	1.38
10	1.31	1.18	0.98	S	0.88	1.44	1.18	1.75	0.94	1.75	1.62	2.25	2.75	1.38	S	2.12	2.38	1.62
11	1.07	1.62	S	0.59	0.88	1.19	1.18	1.50	S	1.50	1.50	2.50	2.75	S	2.00	2.25	2.25	1.62
12	0.98	S	0.88	0.52	0.75	1.38	1.25	S	0.88	1.62	1.75	2.75	2.88	1.75	2.00	2.00	2.25	1.38
13	1.11	1.50	0.94	0.49	0.82	1.75	S	1.38	0.88	1.38	1.62	2.62	S	1.62	2.00	1.75	2.12	S
14	0.94	1.44	0.94	0.55	0.82	S	0.88	1.50	0.82	1.25	2.00	S	3.00	1.88	2.00	2.12	1.75	1.00
15	0.99	1.38	0.94	0.55	0.82	1.44	0.88	1.25	0.68	1.25	S	2.38	3.25	1.88	2.00	2.00	S	1.38
16	0.97	1.38	0.94	0.50	S	1.31	0.81	1.25	0.58	S	1.75	2.12	3.25	1.88	2.00	S	2.00	1.12
17	0.97	1.50	0.94	S	0.82	1.12	0.75	1.18	0.52	1.31	1.75	2.12	3.75	2.00	S	1.88	1.88	1.12
18	0.90	1.75	S	0.80	0.88	0.94	0.88	1.00	S	1.25	1.62	1.38	3.75	S	2.00	1.62	1.75	1.31
19	0.94	S	1.12	0.80	1.06	0.94	0.94	S	0.52	1.38	1.62	1.88	3.75	2.25	2.62	1.62	1.80	1.50
20	1.01	1.75	1.12	0.80	1.06	1.19	S	1.00	0.62	1.38	†	1.75	S	2.12	2.62	1.50	1.58	S
21	0.97	1.62	0.92	0.75	1.12	S	1.00	1.00	0.62	1.38	†	S	3.50	1.88	2.75	1.62	1.30	1.75
22	1.03	1.31	0.80	0.80	1.12	1.31	1.12	0.80	0.70	1.50	S	1.50	4.50	1.62	3.00	1.62	S	1.75
23	1.02	1.18	0.88	0.68	S	1.44	1.00	0.75	0.88	S	†	1.50	3.75	1.50	3.25	S	1.30	†
24	1.06	1.12	1.00	S	1.12	1.44	0.94	0.75	0.82	1.38	1.62	1.50	3.25	1.38	S	1.00	1.38	1.75
25	1.08	1.12	S	0.94	1.25	1.31	1.00	0.88	S	1.38	1.62	1.25	3.00	S	3.25	1.00	1.75	1.88
26	1.22	S	1.25	1.00	1.25	1.50	1.12	S	0.70	1.38	1.50	1.50	3.00	1.62	3.25	1.38	1.75	1.38
27	1.13	1.12	1.12	0.95	1.12	1.50	S	0.94	0.75	1.25	1.50	1.62	S	1.75	3.25	1.25	2.38	S
28	1.08	1.12	0.94	1.05	1.25	S	1.00	1.00	0.75	1.38	1.50	S	2.88	1.50	3.25	1.25	2.12	1.75
29	1.19	0.88	0.80	1.25	1.25	1.50	0.94	1.00	0.81	1.12	S	1.50	2.75	1.38	3.25	1.25	S	1.88
30	1.28	0.88	0.72	1.62	S	1.50	1.00	1.00	1.06	S	1.38	1.50	2.75	1.38	4.25	S	2.12	1.88
31	1.24	1.00	0.62	S	1.50	1.50	1.00	0.94	0.94	1.00	1.38	1.75	3.00	1.38	S	1.50	2.25	1.75
Average for July	$1.14	$1.34	$0.90	$0.81	$1.12	$1.45	$1.07	$1.22	$0.76	$1.43	$1.60	$1.90	$3.05	$1.57	$2.54	$1.75	$1.89	$1.60

August 1	$1.40	$1.00	S	$1.75	$1.94	$1.50	$1.00	$0.80	S	1.06	$1.25	$1.75	$2.88	S	$4.00	$1.88	$2.12	$2.00
2	1.48	S	0.62	1.75	1.69	1.47	1.00	S	$0.75	1.50	0.75	1.38	3.00	$1.38	4.00	2.00	2.00	2.50
3	1.26	1.00	0.62	1.50	1.44	1.47	S	0.62	0.75	1.50	0.75	1.25	S	1.75	4.00	2.00	2.00	S
4	1.18	1.25	0.62	1.38	1.44	S	1.18	0.70	0.75	1.50	0.75	S	3.00	1.75	4.00	2.25	1.88	1.75
5	1.28	1.12	0.68	1.38	1.44	1.56	1.25	0.75	0.75	1.50	S	1.38	3.00	1.62	3.75	2.25	S	1.62
6	1.26	1.00	0.68	1.62	S	1.56	1.12	0.75	0.75	S	1.12	1.50	3.00	1.50	3.75	S	2.25	1.38
7	1.13	0.88	0.75	S	1.31	1.38	0.94	0.88	0.75	1.62	1.12	1.38	3.00	1.50	S	1.75	2.25	1.25
8	1.21	1.00	S	1.62	1.31	1.38	0.94	0.80	S	1.75	1.00	1.00	3.00	S	3.25	1.75	2.25	1.25
9	1.28	S	0.70	1.50	1.19	1.50	0.94	S	0.75	1.75	1.12	1.25	3.00	1.62	3.25	2.25	2.25	1.62
10	1.18	0.88	0.62	1.25	1.19	1.50	S	0.80	0.81	1.62	1.12	1.50	S	2.00	2.50	2.50	†	S
11	1.01	0.75	0.62	1.25	1.19	S	0.81	0.80	0.81	1.75	1.12	S	3.00	2.00	2.25	2.50	2.25	1.62
12	1.18	0.75	0.55	1.25	1.19	1.50	1.00	0.94	0.81	2.00	S	1.50	2.88	1.88	2.25	2.50	S	1.38
13	1.12	0.75	0.60	1.25	S	1.75	0.75	0.75	0.88	S	1.12	1.62	3.00	1.75	2.00	S	2.50	1.38
14	1.00	0.75	0.60	S	1.19	1.31	0.75	0.75	1.00	2.00	1.12	1.62	2.75	1.38	S	2.75	3.12	1.05
15	0.96	0.88	S	1.25	1.12	1.00	0.75	0.70	S	2.25	1.12	1.62	2.50	S	2.25	2.75	3.38	0.92
16	1.02	S	0.88	1.00	1.19	1.00	0.88	S	1.00	2.12	1.12	1.50	2.50	1.62	2.25	3.12	3.38	0.80
17	0.91	0.88	0.88	1.00	1.06	0.87	S	0.70	1.00	2.00	1.25	1.75	S	1.38	2.50	3.25	3.38	S
18	0.88	0.88	0.75	0.88	1.06	S	0.88	0.70	1.00	2.75	1.25	S	2.25	1.38	2.12	3.25	3.25	1.12
19	0.99	0.88	0.94	0.88	1.06	1.00	1.25	0.75	1.00	3.00	S	1.75	2.50	1.00	2.12	3.25	S	1.25
20	1.02	1.12	1.00	1.00	S	1.00	1.25	0.81	1.00	S	1.38	1.88	2.88	1.00	2.12	S	3.25	1.25
21	1.05	1.12	1.00	S	1.06	1.00	1.25	0.88	0.62	2.50	1.38	1.88	2.88	1.00	S	3.38	3.25	1.00
22	0.95	1.12	S	0.75	1.06	0.81	1.25	0.88	S	2.88	1.38	1.88	2.88	S	2.50	3.75	2.50	1.30
23	1.04	S	0.88	1.00	1.00	0.68	1.50	S	1.12	2.12	1.25	2.00	2.00	1.25	2.75	3.25	2.50	1.12
24	0.82	1.50	0.88	1.00	0.90	0.68	S	0.68	1.25	1.75	1.25	2.00	S	1.25	2.62	2.75	2.38	S
25	1.02	1.62	0.88	0.88	0.94	S	1.50	0.75	1.25	1.88	1.38	S	2.00	1.75	2.00	3.00	2.38	1.12
26	1.03	1.62	0.88	0.88	1.00	0.88	1.62	0.75	1.25	1.88	S	1.75	2.50	1.75	2.00	3.00	S	1.00
27	1.02	1.50	1.00	1.00	S	0.84	1.62	0.62	1.25	S	1.25	2.00	2.50	1.75	2.00	S	2.62	1.62
28	1.00	1.50	1.00	S	1.00	0.90	1.62	0.50	1.25	1.50	1.38	2.00	2.50	1.75	S	3.00	2.50	1.12
29	1.10	1.50	S	1.25	1.19	0.90	1.62	0.55	S	1.50	1.38	2.00	2.50	S	2.25	3.25	2.50	0.80
30	1.22	S	1.00	1.25	1.25	0.78	1.62	S	1.25	1.88	1.25	2.00	2.50	2.00	2.75	3.25	2.75	0.92
31	1.02	1.50	1.00	1.25	1.25	1.00	S	0.58	1.25	2.00	1.25	2.00	S	2.50	2.50	3.00	3.25	S
Average for August	$1.10	$1.11	$0.79	$1.21	$1.21	$1.16	$1.16	$0.74	$0.96	$1.91	$1.17	$1.67	$2.71	$1.60	$2.73	$2.73	$2.62	$1.31
September 1	$1.08	$1.50	$1.25	$1.25	$1.25	S	H	$0.75	$1.25	$1.75	$1.12	S	H	$2.50	$2.75	$2.75	$3.25	H
2	1.22	1.50	1.25	1.25	1.25	H	$1.62	0.75	1.88	1.75	S	H	$2.50	3.00	2.75	2.62	S	$0.80
3	1.07	1.50	1.38	1.25	S	$1.00	1.62	0.42	1.88	S	H	$2.50	2.50	3.00	2.50	S	H	1.38
4	1.01	1.50	1.38	S	H	1.00	1.62	0.42	1.88	H	1.25	1.75	2.50	3.00	S	H	3.25	1.32
5	1.22	1.75	S	H	1.25	1.00	2.00	0.62	S	1.75	1.50	2.50	2.50	S	H	2.62	3.00	2.00
6	1.38	S	H	1.25	1.25	1.00	2.00	S	H	1.75	1.38	2.25	2.50	H	2.50	3.25	2.62	1.45
7	1.12	H	1.25	1.12	1.25	1.00	S	H	1.88	2.00	1.38	2.25	S	2.75	2.50	3.25	2.75	S
8	1.25	2.00	1.25	1.12	1.25	S	2.00	0.62	1.88	2.00	1.38	S	2.50	2.50	2.50	3.25	3.00	1.12
9	1.22	2.00	1.25	1.12	1.25	1.00	2.00	0.75	1.50	2.00	S	2.50	2.50	2.50	2.50	2.38	S	2.12
10	1.19	2.00	1.25	1.12	S	0.88	2.00	0.75	2.00	S	1.38	2.50	†	2.50	2.50	S	3.00	1.38
11	1.28	2.00	1.25	S	1.25	0.75	2.00	1.12	1.50	1.75	1.38	2.25	2.50	2.50	S	2.38	3.00	1.25
12	1.07	2.00	S	1.25	1.25	0.50	1.25	1.12	S	1.75	1.38	3.25	2.50	S	2.50	2.12	3.25	1.88
13	1.06	S	1.25	1.25	1.25	0.50	1.25	S	†	1.75	1.38	3.25	2.50	2.50	2.50	2.75	3.25	1.75
14	0.98	2.00	1.50	1.25	1.06	0.50	S	1.12	†	1.75	1.50	3.25	S	2.50	2.50	2.50	3.25	S
15	1.23	2.00	1.25	1.25	1.06	S	1.50	1.12	†	1.75	1.50	S	2.50	2.00	4.00	†	3.25	1.88

* Prices given in this table are averages, from the *Producers' Price-Current*, of the high and the low prices quoted for state peas per basket. On days when no quotations for peas of this description were given, the prices for state peas per bag, the average price for state peas large and state peas small per basket, or the prices for ordinary peas, were used. S = Sunday. H = Holiday.

† No quotations available

TABLE 45 (*concluded*)

	5-years average, 1910–1914	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
September 16	$1.14	$2.12	$1.25	$1.25	$1.06	$0.88	$1.50	$1.00	†	$1.75	S	$2.75	$2.75	$2.00	$4.00	†	S	$1.12
17	1.16	2.12	1.75	1.25	S	0.88	1.50	1.00	†	S	$1.50	2.75	2.75	2.00	4.00	S	$3.25	1.12
18	1.11	2.12	1.75	S	1.06	0.88	1.50	1.00	†	1.75	1.50	2.75	2.75	2.00	S	†	5.00	1.62
19	1.14	2.12	S	1.25	1.06	0.88	1.50	1.00	S	†	1.38	2.75	2.75	S	4.00	†	†	1.62
20	1.21	S	1.75	1.25	†	0.88	1.50	S	†	†	1.38	3.00	2.75	2.00	4.00	†	†	1.62
21	1.04	2.12	1.75	1.25	†	0.88	S	1.00	†	†	1.50	3.75	S	2.00	4.00	†	5.00	S
22	1.12	2.12	1.75	1.25	†	S	†	1.00	†	†	1.50	S	2.75	2.00	4.00	†	5.00	2.00
23	1.17	2.00	1.75	1.25	†	0.75	†	1.50	†	†	S	3.75	2.75	2.00	4.00	†	S	2.25
24	1.17	†	1.75	1.25	S	0.75	†	1.50	†	S	1.50	3.75	2.75	†	4.00	S	5.00	2.25
25	0.82	†	1.75	S	†	0.75	†	0.88	†	†	1.50	3.75	2.75	†	S	†	5.00	2.50
26	0.82	†	S	†	†	0.75	†	0.88	S	†	1.50	3.25	†	S	†	†	5.00	2.25
27	0.75	S	1.75	†	†	0.75	†	S	†	†	1.50	3.25	†	†	†	†	5.50	2.25
28	0.82	†	1.75	†	†	0.75	S	0.88	†	†	1.50	3.25	S	†	†	†	†	S
29	0.88	†	1.50	†	†	S	†	0.88	†	†	1.50	S	†	†	†	†	†	2.25
30	0.82	†	1.50	†	†	0.75	†	0.88	†	†	S	3.25	†	†	†	†	S	2.25
Average for September	$1.08	$1.92	$1.49	$1.22	$1.19	$0.82	$1.67	$0.92	$1.74	$1.80	$1.43	$2.93	$2.61	$2.38	$3.20	$2.72	$3.78	$1.74

† No qouotations available.

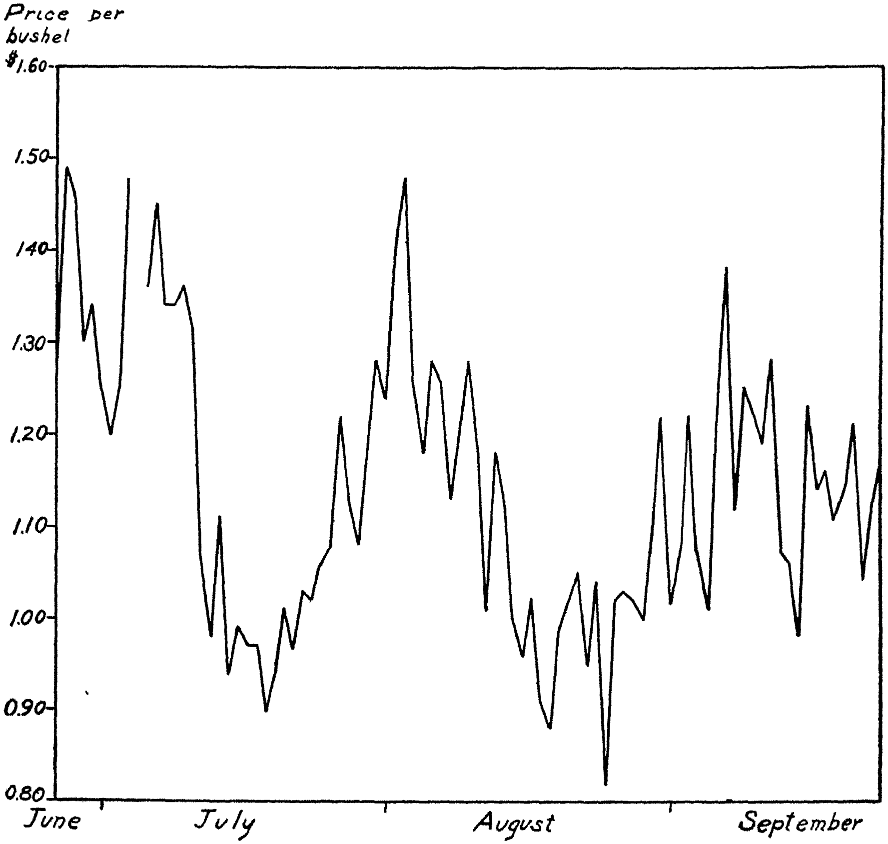


FIGURE 2. WHOLESALE PRICE OF STATE PEAS PER BUSHEL BASKET IN NEW YORK CITY
Five-years average (1910–1914), from the *Producers, Price-Current*

July are the highest of the season. The demand is increased at that time because of Independence Day. For two weeks thereafter until July 20, prices decline; for the succeeding two weeks until about August 5, prices rise; for the next two weeks, prices again decline and reach a point as low as that for the middle of July; for the remainder of the season, prices increase. The reason for these three periods of relatively high prices and two periods of low prices is that the crop from the first planting, or the early-pea crop, is followed by a crop of later varieties that come on the market in about three weeks. The prices received for these later peas are lowest during the last week of August. This is probably due to heavy shipments and to the fact that many vacations occur at this time, causing a decreased demand.

If the grower is able to produce a crop of peas that will reach the market from two to three weeks earlier or from two to three weeks later than most of the crop, he then realizes the highest price. This may be done by early or late planting. If he can obtain a good yield by this practice, more

money is then made on the crop. A period of about two months from the date of planting is required for peas to mature. To realize the high price paid on July 1, planting at the end of April is necessary; to realize the high price paid on August 1, planting about the last of May is necessary; and to realize the high price paid in September, planting during the first week in July is necessary. Probably most of the plantings are made from one to two weeks later than these dates.

Madison and Chenango Counties, because of cool weather in the growing season, a limestone soil, and a heavy rainfall, can grow peas for market later in the season than can many other sections. The shipping points are well situated on the Delaware, Lackawanna & Western Railroad, which runs thru New Jersey cities and on to New York City.

Canning-factory peas

The relation of the percentage of normal of the May and June rainfall at Cortland, to the yield of factory peas per acre on all acres grown for one Cortland factory, is given in tables 46 and 47. The average yield per acre for the eight years from 1916 to 1923 was 1892 pounds, but it varied from 1251 pounds in 1919 to 2533 pounds in 1920.

From these tables it appears that wet years in this region, especially when there are heavy rainfalls in May, result in lower yields of peas per acre than do dry years. The normal rainfall at Cortland is 3.87 inches for May and 4.15 inches for June. This is exceptionally heavy, and 60 per cent of the normal rain for Cortland would be almost as much as the normal fall in some other regions where peas are grown.

A four-years average yield of late peas for the canning factory delivered to one company in the vicinity of the regions shown in table 48 was 1690 pounds per acre; of early varieties in the same years, the yield was 1326 pounds per acre, or 364 pounds per acre less than the late varieties. The yield of late peas, therefore, averaged 27 per cent more than that of early varieties. The variations were from 14 per cent more in 1921 and 1923,

TABLE 46. RELATION OF MAY AND JUNE RAINFALL AT CORTLAND, TO AVERAGE YIELD OF PEAS FOR THE CANNING FACTORY

Year	Rainfall, in per cent of normal	Yield of peas, per acre	
		Average number of pounds	Per cent of 8-years average
1916	110	1,784	94
1917	161	2,021	107
1918	122	2,053	109
1919	91	1,251	66
1920	59	2,533	134
1921	56	2,225	118
1922	223	1,389	73
1923	62	1,876	99

TABLE 47. RELATION OF MAY AND JUNE RAINFALL AT CORTLAND, TO AVERAGE YIELD OF PEAS FOR THE CANNING FACTORY

	Rainfall, in per cent of normal		
	Less than 90 per cent	From 90 to 115 per cent	More than 115 per cent
May rain only:			
Average rainfall, in per cent of normal	62	112	140
Number of years included	4	2	2
Average yield per acre, in pounds	2,006	1,902	1,652
Yield per acre, in per cent of eight-years average	106	100	88
June rain only:			
Average rainfall, in per cent of normal	58	102	286
Number of years included	4	2	2
Average yield per acre, in pounds	1,971	1,918	1,705
Yield per acre, in per cent of eight years average	104	102	90
May and June rain combined:			
Average rainfall, in per cent of normal	59	100	169
Number of years included	3	2	3
Average yield per acre, in pounds	2,211	1,518	1,821
Yield per acre, in per cent of eight years average	117	80	96

to 54 per cent more in 1924. The 17-per-cent higher price paid for early peas, the fact that they can be harvested before the rush of haying, and the fact that they can be taken from the field earlier than late peas, thus giving a better opportunity for growth of the seeding, offset almost, if not entirely, the advantage of a higher yield of late peas. Harvesting of early peas, however, conflicts with the setting of cabbage.

Altho data for only four years are available, the same relationship of low yields in wet years and high yields in dry years is shown for Onondaga and Oneida Counties (table 48) as is shown for Cortland. No relationship appears for Livingston County. The yield of early peas was 47 per cent more in the dry years than in the wet years in one area of Onondaga County, and 30 per cent more in one area of Oneida County. The yield of late peas was 63 per cent and 59 per cent more, respectively, in years when May and June were dry, than when there were heavy rainfalls during these two months.

Since the price of peas is set in advance by contract with the canning companies, the value per acre depends almost entirely upon the rainfall, but the price has no relation to the rainfall or to the size of the crop.

In 1921, peas for the cannery in the vicinity of Tully and Homer returned \$47 per acre above the cost of seed.[9] Market peas in this area returned to growers \$92 per acre above the cost for seed, labor, baskets, express, and commissions. Probably thru a period of years, market peas pay better than factory peas; but the risks of the market crop are twofold

[9] Bulletin 433 of this experiment station, page 107.

— extremely low prices and poor crops — and therefore the profits are more variable from year to year. There is less risk in handling factory peas, and probably the profits are less because of a contracted price.

TABLE 48. YIELD OF CANNING-FACTORY PEAS, EARLY AND LATE VARIETIES, IN POUNDS OF SHELLED PEAS PER ACRE

Year	Onondaga County		Oneida County		Livingston County		Average	
	Yield	May and June rainfall, in per cent of normal	Yield	May and June rainfall, in per cent of normal	Yield	May and June rainfall, in per cent of normal	Yield	May and June rainfall, in per cent of normal
	Early peas							
1921	1,208	99	1,269	76	1,320	58	1,266	78
1922	1,078	321	908	166	1,439	132	1,142	206
1923	1,730	88	1,280	101	1,458	118	1,489	102
1924	1,638	82	1,574	75	1,007	118	1,406	92
Average	1,414	....	1,258	....	1,306	....	1,326	......
	Late peas							
1921	1,304	......	1,958	......	1,066	....	1,443	....
1922	1,432	......	901	......	2,012	......	1,448	......
1923	1,978	......	1,721	......	1,400	....	1,700	......
1924	2,469	.	2,223	..	1,816	....	2,169	......
Average	1,796	.....	1,701	...	1,574	....	1,690	......
Yield per acre of late peas above that of early peas	382	....	443	....	268	....	364	....

FERTILITY MAINTENANCE

The use of fertilizers and lime is summarized in tables 49 and 50.

Of the fertilizer used, 28.3 per cent was acid phosphate, 13.3 per cent was 2-8-2, 12.7 per cent was 2-8-4, 10.9 per cent was 2-8-10, these comprising 65.2 per cent of all the fertilizer purchased. The remainder was of various brands. The average cost of 258.8 tons of purchased fertilizer was $37.55 per ton.

The pounds of commercial fertilizer used per acre fertilized averaged: for corn for grain, 289 pounds; for corn for the silo, 288 pounds; for oats, 217 pounds; for wheat, 276 pounds; for potatoes, 684 pounds; for cabbage, 524 pounds; for market peas, 307 pounds.

A total of 481.1 tons of lime, 4 tons to a farm, was used, of which 98.7 per cent was ground limestone. The average application for oats was 1779 pounds per acre, and for cabbage 1413 pounds per acre.

Of the manure, 34.6 per cent was used for corn for the silo, 5.4 per cent for cabbage, 1.9 per cent for potatoes, 28.8 per cent for new seedings, and 22.1 per cent for old meadows. The remaining 7.2 per cent was used for miscellaneous crops.

TABLE 49. SUMMARY OF FERTILIZER AND LIME USED ON 121 FARMS

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
For corn for grain:					
Acid phosphate	2	27	5,500	......	$88
0-10-2	1	5	1,120	......	23
2-6-4	1	4	2,000	......	36
2-8-4	3	8	3,132	......	50
2-8-10	1	3	1,000	......	18
3-10-0	1	4	2,000	......	50
Total fertilizer	9	51	14,752	289	$265
For corn for fodder:					
2-8-2	1	5	1,000	......	$18
2-10-4	1	3	900	......	19
Total fertilizer	2	8	1,900	238	$37
For corn and buckwheat:					
Acid phosphate	1	25	10,000	......	$105
Total fertilizer	1	25	10,000	400	$105
For corn for the silo:					
Acid phosphate	10	118.5	35,170	......	$419
0-10-2	1	11	5,500	......	100
1-8-2	1	8	1,600	......	26
1-8-4	2	12.5	6,600	......	131
1-10-0	1	8	3,600	......	69
1-11-0	1	4	1,600	......	16
2-8-0	1	9	1,000	......	20
2-8-2	15	141	37,800	......	689
2-8-3	2	28	6,000	......	130
2-8-4	5	33	10,914	......	213
2-8-6	3	39	10,910	......	249
2-8-10	4	34.5	11,361	......	242
2-9-2	1	4	500	......	10
2-10-0	4	33	8,250	......	148
2-10-4	1	4	1,200	......	25
2-12-2	1	10	2,000	......	40
3-8-3	1	8	4,000	......	76
3-10-0	1	12	3,200	......	59
4-8-2	1	10	1,000	......	20
4-8-4	1	7	1,500	......	29
Total fertilizer	55	534.5	153,705	288	$2,711
Hydrated lime	1	12	6,000	500	$54
Ground limestone	3	38	39,574	1,041	$133
For oats:					
Acid phosphate	18	182	41,725	......	$562
0-10-2	1	13	1,335	......	26
0-10-4	1	7	1,750	......	29
1-8-1	3	23	6,400	......	110
1-8-2	2	23	4,650	......	75
1-8-4	2	8	2,600	......	49
1-11-0	1	7	2,400	......	26
2-8-2	6	52.5	12,975	......	223

TABLE 49 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
For oats (*concluded*):					
2-8-3	1	10	1,500	....	$ 28
2-8-4	7	70.5	17,300	..	353
2-8-6	1	4	800	.	18
2-8-10	2	28	4,750	...	92
2-10-0	5	52	9,425	.	171
4-8-2	1	25	2,000		40
Total fertilizer	48	505	109,610	217	$1,802
Hydrated lime	1	0.5	100	200	$1
Ground limestone	29	317.5	564,721	1,779	$1,450
For oats and barley:					
1-8-1	1	12	900	..	$13
Total fertilizer	1	12	900	75	$13
Ground limestone	1	11	30,000	2,727	$68
For barley:					
Acid phosphate	2	9	1,900	.....	$23
0-10-4	2	14	2,800	.....	50
2-8-4	2	9	1,450	......	29
3-8-3	1	6	600	.....	10
Total fertilizer	7	38	6,750	178	$112
Ground limestone	3	18	32,000	1,778	$93
For buckwheat:					
Acid phosphate	1	5	1,000	.....	$15
2-8-4	1	2	600	....	12
2-8-6	1	1.5	300	.....	7
3-8-3	1	1.5	400	......	7
Total fertilizer	4	10	2,300	230	$41
For wheat:					
1-10-0	1	4	800	.....	$ 15
2-8-2	1	1.5	562	......	8
2-8-3	1	4	600	.....	11
2-8-10	1	17	5,625	......	132
3-8-3	1	5	1,000	......	19
3-8-4	1	5	1,500	......	34
Total fertilizer	6	36.5	10,087	276	$219
Ground limestone	3	13	20,000	1,538	$97
For millet:					
0-10-4	1	2	300	......	$6
2-8-4	1	1	300	......	6
Total fertilizer	2	3	600	200	$12
For sudan grass:					
2-8-4	1	2	600	......	$12
Total fertilizer	1	2	600	300	$12

TABLE 49 (*continued*)

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
For alfalfa:					
2–8–6	1	1	300	...	$6
Kinds not found	1	2	400	...	6
Total fertilizer	2	3	700	233	$12
Ground limestone	7	19	60,000	3,158	$173
For hay:					
Hydrated lime	1	10	5,000	500	$45
Ground limestone	7	91	137,340	1,509	$285
For potatoes:					
Sodium nitrate	2	1.5	250	......	$ 8
Acid phosphate	9	15.3	12,510	......	145
0–10–2	2	7	2,360	......	60
1–8–4	1	1	400	......	8
1–9–4	1	3	1,500	......	60
2–8–2	10	11.5	7,219	......	177
2–8–4	8	12.7	11,000	......	231
2–8–6	2	4	3,000	......	72
2–8–10	10	18	13,911	......	316
2–9–2	1	1.5	1,500	......	32
3–6–0	1	0.5	500	......	11
3–8–3	2	5.5	4,200	......	90
3–8–4	1	1	300	......	6
3–8–6	1	1	500	......	15
4–8–2	1	5	3,000	......	60
4–8–4	2	3	2,000	......	40
Kinds not found	3	9	4,600	......	128
Total fertilizer	45	100.5	68,750	684	$1,459
For cabbage:					
Sodium nitrate	2	6.5	1,400	......	$ 42
Acid phosphate	14	42.8	30,490	......	377
1–8–4	3	7	2,900	......	64
2–8–0	1	2	1,200	......	24
2–8–2	7	19.5	7,819	......	127
2–8–3	1	4	1,200	......	29
2–8–4	7	11.8	10,200	......	205
2–8–5	1	1	800	......	18
2–8–6	2	10	3,460	......	80
2–8–8	1	2	2,000	......	52
2–8–10	8	38.5	10,600	......	453
2–10–0	4	9.5	7,000	......	133
2–12–2	1	1	1,500	......	30
3–8–3	1	2	1,200	......	23
3–8–4	1	4	1,600	......	32
3–8–6	1	2	900	......	27
3–10–3	1	2	1,600	......	48
4–8–0	1	1.5	2,000	......	43
4–8–4	3	7.5	4,650	......	108
Kinds not found	2	6	2,100	......	74
Total fertilizer	59	180.6	94,619	524	$1,989

TABLE 49 (*concluded*)

…ilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds used per acre fertilized	Cost of fertilizer
…luded):					
……………	1	2	1,000	500	$9
…ne………	12	47	66,389	1,413	$201
……………	6	20	6,000	……	$ 90
……………	1	6	4,000	……	100
……………	3	7	955	……	19
……………	1	1.5	600	……	8
……………	4	7.5	2,300	……	47
……………	3	10	1,750	……	36
……………	1	4	800	……	15
……………	3	29	10,150	……	197
……………	1	3.5	1,400	……	31
……………	3	32	9,100	……	215
……………	1	1	350	……	6
…d………	2	8	2,300	……	87
…er………	29	129.5	39,705	307	$851
……………	1	1	150	……	$ 4
……………	1	1	450	……	43
…er………	1	2	600	300	$47
……………	1	2	2,000	……	$31
…er………	1	2	2,000	1,000	$31
…t used)………	1	……	………	……	$9

TABLE 50. TOTAL FERTILIZER AND LIME USED

…tilizer and lime	Pounds used	Per cent of total pounds	Value	Average price per ton
……………	1,800	0.3	$ 54	$60.00
……………	146,745	28.3	1,898	25.87
……………	4,000	0.8	100	50.00
……………	11,270	2.2	228	40.46
……………	4,850	0.9	85	35.05
……………	7,900	1.5	131	33.16
……………	6,250	1.2	101	32.32
……………	14,800	2.9	299	40.41
……………	1,500	0.3	60	80.00
……………	4,400	0.8	84	38.18
……………	4,000	0.8	42	21.00

Corn for…
Corn sila…
Corn, gr…
Corn, su…
Corn fod…
Oats…
Oats and…
Oats, pe…
Wheat…
Buckwh…
Hay, first…
Hay, old…
Alfalfa…
Alfalfa s…
Timothy…
Cabbage…
Potatoes…
Peas…
Pasture…
Strawber…
Tota…
Not used…

By remo…
Total…
Per acre…
orch…
By addit…
Nodule…
Comm…
Lime…
Seed…
Straw, …
ding…
Dry fora…
Succulent…
Concentr…
Amount…
Per acre…
Removal…
acre ‡…

* Includi…
† Feed s…
‡ When…

TABLE 50 (*concluded*)

Forms of fertilizer and lime	Pounds used	Per cent of total pounds	Value	Average price per ton
2-6-4	2,000	0.4	$ 36	$36.00
2-8-0	2,200	0.4	44	40.00
2-8-2	69,125	13.3	1,278	36.98
2-8-3	10,100	1.9	213	42.18
2-8-4	65,646	12.7	1,308	39.85
2-8-5	800	0.1	18	45.00
2-8-6	20,170	3.9	463	45.91
2-8-8	2,000	0.4	52	52.00
2-8-10	56,347	10.9	1,468	52.11
2-9-2	2,000	0.4	42	42.00
2-10-0	24,675	4.8	452	36.64
2-10-4	2,100	0.4	44	41.90
2-12-2	3,500	0.7	70	40.00
3-6-0	500	0.1	11	44.00
3-8-3	11,750	2.3	231	39.32
3-8-4	3,400	0.7	72	42.35
3-8-6	1,400	0.3	42	60.00
3-10-0	5,200	1.0	109	41.92
3-10-3	1,600	0.3	48	60.00
4-8-0	2,000	0.4	43	43.00
4-8-2	6,000	1.2	120	40.00
4-8-4	8,150	1.6	177	43.44
Kinds not found	9,400	1.8	295	62.77
Total fertilizer	517,578	100.0	$9,718	$37.55
Fertilizer held (not used)	....	......	$9	....
Lime:				
Ground limestone	950,024	98.7	$2,500	$ 5.26
Hydrated lime	12,100	1.3	109	18.02
Total lime	962,124	100.0	$2,609	$5.42

The average rate of spreading manure for all crops was 12 tons per acre. The rate was 14.6 tons for corn for the silo, 11.4 tons on new seedings, 9.8 tons on old meadows, 13.6 tons for cabbage, and 8.3 tons for potatoes. (Table 51.)

A fertility-balance computation was made similar to those given in the preceding bulletins in this series (table 52). Apparently about 4 pounds more of nitrogen (N) was added per acre than was removed by the crops, 5 pounds more of phosphoric acid (P_2O_5), and 72 pounds more of lime (CaO); but 22 pounds less of potash (K_2O) was added. The generalization regarding the fertility question is no different for this area from what it is for other areas previously reported: the fertility balance is maintained, except for potash.

TABLE 51. USE OF MANURE ON 121 FARMS

Crop	Number of farms using	Acres manured	Tons applied	Tons per acre manured	Per cent of tons applied
Corn for grain	11	30.5	421	13 8	1 4
Corn silage	90	705	10,286	14.6	34 6
Corn, green	2	2	45	22 5	0 2
Corn, surplus	2	4	80	20.0	0 3
Corn fodder	2	3	55	18 3	0 2
Oats	6	27	265	9 8	0.9
Oats and peas	2	1.5	16	10.7	0 0
Oats, peas, and barley	1	25	101	4.0	0 3
Wheat	1	3	12	4.0	0.0
Buckwheat	1	1	4	4.0	0 0
Hay, first year	93	750.5	8,570	11 4	28 8
Hay, old meadow	63	668.6	6,570	9.8	22.1
Alfalfa	2	4	51	12.8	0.2
Alfalfa seeding	1	2	36	18.0	0.1
Timothy	2	49	659	13.4	2.2
Cabbage	42	117.9	1,600	13 6	5.4
Potatoes	26	68.6	566	8.3	1 9
Peas	4	10.5	133	12.7	0.4
Pasture	1	12	285	23.8	1.0
Strawberries	1	0 8	10	12 5	0.0
Total	....	2,485 9	29,765	12.0	100.0
Not used	....	....	76	.....	....

TABLE 52. FERTILITY-BALANCE STATEMENT FOR 121 FARMS

	Pounds of plant food				Tons of organic matter
	N	P_2O_5	K_2O	CaO	
By removal in crops grown:					
Total	379,393	130,093	443,491	165,664	....
Per acre of crops, excluding orchard (7,600.2 acres)	50	17	58	22	....
By addition:					
Nodule fixation	94,623	....	....	....	....
Commercial fertilizer	6,134	54,330	14,559	74,795	....
Lime	.....	......	....	540,725	....
Seed	5,334	1,726	1,983	212	100.5
Straw, hay, etc., for bedding*	11,201	3,918	25,300	7,781	805.9
Dry forage fed †	113,647	39,273	146,623	55,464	2,846.1
Succulent feed fed †	53,091	27,973	65,258	28,580	1,450.5
Concentrates fed †	125,533	40,956	21,560	8,860	1,454.6
Amount added (total) ‡	409,563	168,176	275,283	716,417	6,657.6
Per acre	54	22	36	94	0.88
Removal less addition per acre ‡	+4	+5	−22	+72	....

* Including hopvines that were returned to the soil.
† Feed supplementary to pasture excluded.
‡ When it is considered that 60 per cent of the N, 70 per cent of the P_2O_5, 60 per cent of the K_2O, 60 per cent of the CaO, and 45 per cent of the dry matter in feed, is returned in manure.

LABOR DISTRIBUTION

The distribution of labor (figure 3) was computed the same as in the preceding bulletins of this series. Of the total labor, 65.9 per cent was spent on cattle, 2.3 per cent on other livestock, 18.6 per cent on cultivated

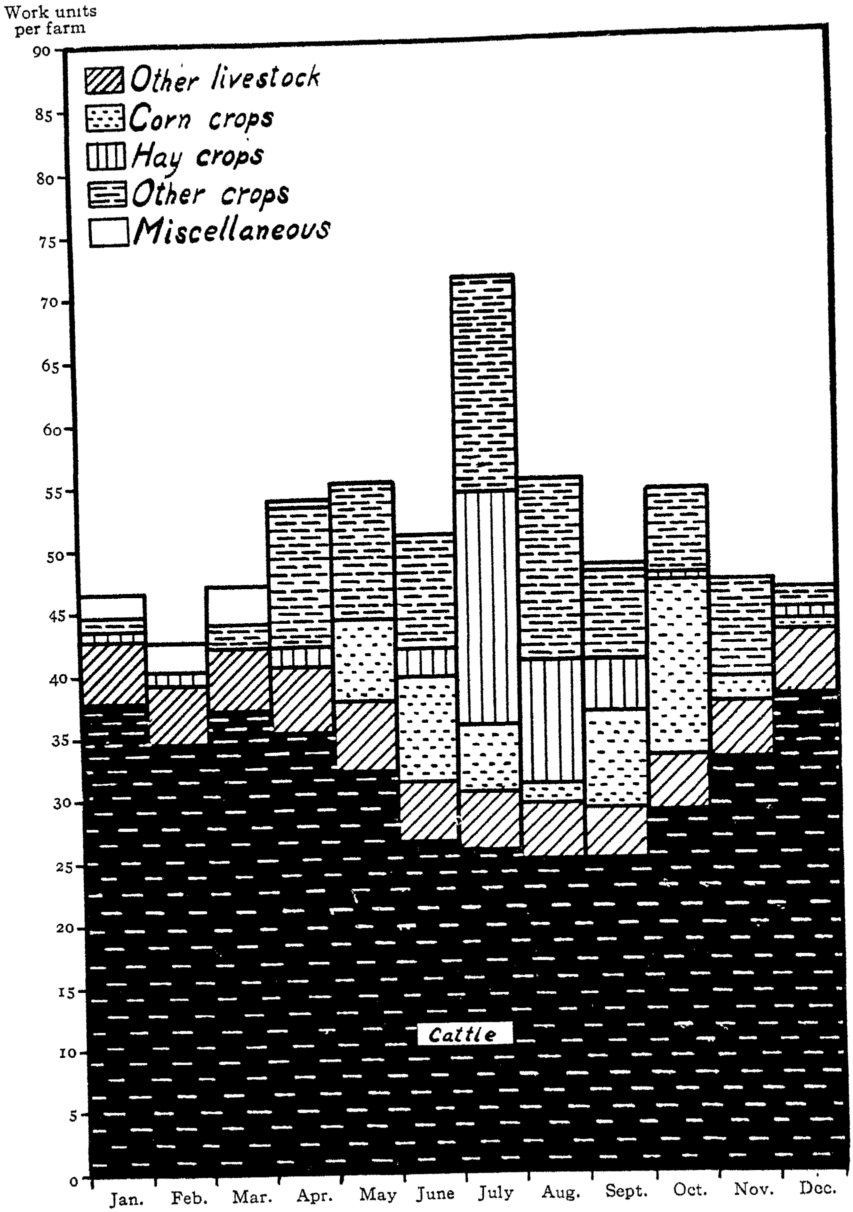


FIGURE 3. DISTRIBUTION OF MAN LABOR ON 121 FARMS IN 1921

TABLE 53. SUMMARY OF WORK UNITS ON 121 FARMS

	Cattle	Other livestock	Culti-vated crops	Grain crops and annual hay crops	Hay	Other crops	Miscel-laneous	Total	Per cent on cattle	Per cent for each month
January	4,568	598	131	16	91	6	228	5,638	81 0	7 5
February	4,157	582	96	4	100	7	195	5,141	80 9	6 9
March	4,476	620	100	13	79	20	363	5,671	78 9	7 6
April	4,248	657	899	482	119	33	137	6,575	64.6	8.8
May	3,882	651	1,592	420	83	18	....	6,646	58.4	8 9
June	3,197	581	2,029	65	254	9	....	6,135	52.1	8 2
July	3,106	551	2,608	111	2,216	21	....	8,613	36.1	11.5
August	3,015	534	920	981	1,175	28	19	6,672	45 2	8.9
September	3,015	497	1,120	589	507	35	50	5,813	51.9	7.8
October	3,471	525	2,195	193	57	103	....	6,544	53.0	8.8
November	3,974	544	966	139	35	17	....	5,675	70.0	7 6
December	4,568	593	238	50	118	3	....	5,570	82.0	7 5
Total including labor on horses	45,677	6,933	12,894	3,063	4,834	300	992	74,693	......	100 0
Total excluding labor on horses	45,677	1,569	12,894	3,063	4,834	300	992	69,329	....	.....
Per cent	65 9	2.3	18.6	4 4	7.0	0 4	1.4	100.0	......	....

crops, 4.4 per cent on grain and annual hay crops, 7 per cent on hay, and 1.8 per cent for other crops and for miscellaneous labor (table 53).

The proportion of the labor in each month devoted to cattle ranged from 36.1 per cent in July to 82 per cent in December, a variation of approximately one-third to four-fifths.

The productive work units, excluding work on horses, averaged 246 per man and 62 per work animal; there were 2.33 men and 3.7 work animals per farm. The average acres of crops per man was 27.3 and per work animal 17.2.

There is a good distribution of labor on these farms, varying from 6.9 per cent of the total labor in February to 11.5 per cent in July. Both the large proportion of purebred cattle on these dairy farms, and the cash crops raised, tend to make a better distribution and a more efficient use of labor.

SUMMARY OF AVERAGES

The averages of many farm-business factors for the area studied are shown in table 54. The more important factors are given in table 55.

TABLE 54. SUMMARY FOR COMPARING INDIVIDUAL FARMS WITH THE AVERAGE FOR 121 FARMS

	Average for 121 farms	Individual farms
Year of record, ending April 30	1922	....
County	Chenango	....
Labor income	+$321	....
Labor income if pool prices had been received	+$209	....
Size of business:		
1. Productive man-work units	573	....
2. Acres of crops	63.5	....
3. Acres pastured (woods in equivalent of open pasture)	74 5	....
4. Number of cows, average	23	....
5. Number of men, including operator	2.33	....
6. Capital	$16,586	....
7. Hundredweight of milk sold per farm	1,308	....
8. Animal units per farm:		
Including work animals	33 4	....
Excluding work animals	29 7	....
Type of business:		
9. Average miles to milk station	1.8	....
10. Per cent of total productive man-work units on:		
Cattle	65.9	....
Cultivated crops	18.6	....
Grain crops and peas	4.4	....
Hay	7 0	....
All else	4 1	....
11. Total productive man-work units on farm per acre of crops	9.0	....
12. Per cent of capital in:		
Real estate	67	....
Livestock	25	....
Equipment and supplies	8	....
13. Per cent of cows freshening from September to December, inclusive	0.	....

TABLE 54 (*continued*)

	Average for 121 farms	Individual farms
Type of business (*concluded*):		
14. Per cent of milk sold during:		
May, June, July	28 0	....
August, September, October	19.7	....
November, December, January	24.4	....
February, March, April	27 9	....
15. Average weight of cows (pounds)	940	....
16. Average weeks cows are dry	8.2	....
17. Per cent of cows less than four years old	32.4	....
18. Per cent of cows replaced	22.2	....
19. Per cent of cows added that were raised at home	66 0	....
20. Per cent of cows added that were purchased	34.0	....
21. Average age of heifers when freshening for first time (months)	27.9	....
22. Grade of milk	Grade B	....
23. Per cent of milk produced which is sold	93.1	....
24. Per cent of milk kept at farm	6.9	....
Balance of business:		
25. Pasture acres per animal unit pastured	2.5	....
26. Acres of crops per animal unit	1.9	....
27. Manure per acre of crops (tons)	3.9	....
28. Manure applied per acre of crops receiving manure (tons)	12.0	....
29. Value of purchased fertilizer per acre of crops	$1.26	....
30. Labor distribution (good, fair, poor)	Good	....
31. Important sources of income, and receipts from each, per farm:		
Milk	$2,740	....
Appreciation on cattle*	$528	....
Crops sold	$1,043	....
32. Elements removed per acre by crops (pounds):		
Nitrogen	50	....
Phosphoric acid	17	....
Potash	58	....
Lime (CaO)	22	....
33. Elements added per acre (pounds):		
Nitrogen †	54	....
Phosphoric acid	22	....
Potash	36	....
Lime (CaO)	94	....
34. Per cent of receipts from crops	20.5	....
Rates of production:		
35. Crop index, all crops (based on average yields for New York State)	119.1	....
36. Crop index:		
Corn for the silo	216 2	....
Oats (threshed)	92.6	....
Hay	102 3	....
37. Pounds of milk produced per cow	6,184	....
38. Pounds of milk sold per cow	5,759	....
39. Pounds of milk produced per dollar invested in cows	55	....
40. Value of milk and its products sold per cow	$121	....
41. Appreciation on cattle per cattle unit	$18.47	....

* Includes value of calves born during the year.
† No account is taken of nitrogen added by free fixation and by precipitation.

TABLE 54 (*continued*)

	Average for 121 farms	Individual farms
Labor efficiency:		
42. Productive man-work units per man	246	......
43. Acres of crops per man	27.3	......
44. Animal units, except work animals, per man	12.7	......
45. Productive horse-work units per work animal	62	......
46. Acres of crops per work animal	17.2	......
47. Labor returns per man	$542	......
48. Labor returns per man-work unit	$2.21	......
49. Per cent of farms using milking machines	58	......
50. Per cent of months machines are used	83	......
51. Hundredweight of milk produced per man	603	......
Human labor:		
Hours per cow per year:		
52. Milking	67	......
53. Hauling milk	15	......
54. Other labor	70	......
Hours per 100 pounds of milk produced:		
55. Pasture season	1.8	......
56. Winter	2.9	......
57. For year	2.5	......
Capital efficiency:		
58. Value of crop land per acre	$55.04	......
59. Value of pasture land per acre	$24.56	......
60. Value of woodland per acre	$18.53	......
61. Value of houses per farm	$2,194	......
62. Value of cattle barns per farm	$2,154	......
63. Value of other buildings per farm	$944	......
64. Per cent of real-estate capital in buildings	47.6	......
65. Per cent of real-estate capital in land	52.4	......
66. Value of machinery and equipment per acre of crops	$19.40	......
Feeding efficiency:		
Feed:		
Per cow per year:		
67. Concentrates (pounds)	2,183	......
68. Silage (pounds)	7,953	......
69. Other succulent feed (pounds)	915	......
70. Dry forage (pounds)	3,560	......
71. Protein (digestible pounds)	......	......
72. Energy (therms)	......	......
73. Days of pasture	160	......
Per cow per day during winter:		
74. Concentrates (pounds)	8.9	......
75. Silage (pounds)	35.5	......
76. Other succulent feed (pounds)	1.7	......
77. Dry forage (pounds)	17.1	......
78. Protein (digestible pounds)	......	......
79. Energy (therms)	......	......
80. Protein-energy ratio	......	......
Per 100 pounds of milk produced in pasture period:		
81. Days of pasture	6.3	......
82. Concentrates (pounds)	13.8	......
83. Silage and other succulent feed (pounds)	49.5	......
84. Dry forage (pounds)	2.5	......
Per 100 pounds of milk produced in winter period:		
85. Concentrates (pounds)	50.2	......
86. Silage (pounds)	198.9	......

TABLE 54 (*concluded*)

	Average for 121 farms	Individual farms
Feeding efficiency (*concluded*):		
Feed (*concluded*):		
Per 100 pounds of milk produced in winter period (*concluded*):		
87. Other succulent feed (pounds)	9 4	....
88. Dry forage (pounds)	95.7	....
89. Protein (digestible pounds)	....	......
90. Energy (therms)	....	......
Per 100 pounds of milk produced thru the year:		
91. Concentrates (pounds)	35.3	......
92. Silage (pounds)	128.6	......
93. Other succulent feed (pounds)	14.8	....
94. Dry forage (pounds)	57.6	....
95. Protein (digestible pounds)	....	....
96. Energy (therms)	....	....
Costs and returns for cows:		
97. Total costs per cow	$177	....
98. Returns, exclusive of milk sold wholesale	$30	.....
99. Cost of milk sold per cow	$147	....
100. Value of milk sold, cash per cow	$113	......
101. Certificates of indebtedness, per cow	$7	......
102. Gain or loss per cow (loss)	$27	.....
103. Price received per 100 pound of milk	$2.10	....
104. Cost of producing 100 pounds of milk	$2.56	.....
105. Loss per 100 pounds of milk	$0 46	....
Cost of raising a heifer:		
106. To two years of age	$127	.....
107. To age of freshening (approximate)	$148	....

TABLE 55. IMPORTANT BUSINESS FACTORS FOR 121 DAIRY FARMS WITH CASH CROPS AND MIXED HAY ROUGHAGE
(Arranged according to size of farm operated)

Farm no.	Acres operated	Acres of crops	Number of cows	Average total capital	Man equivalent	Milk sales	Crop sales	Farm expenses	Plus labor income	Minus labor income	Cow cost of milk per hundredweight	Pounds of milk produced per cow
380	43	22	9.5	$ 6,880	1.4	$1,243	$ 142	$1,016	$ 411	......	$2.60	6,634
397	58	30.8	17.5	13,404	2.7	1,934	2,407	4,517	201	......	3.76	5,524
414	60	24	15.5	11,375	2.0	2,143	......	2,141	653	......	1.99	7,666
417	60	30.2	13	7,662	1.6	2,159	513	3,190	2,138	......	2.39	7,790
406	62.5	30	14.5	7,145	1.6	1,146	1,207	1,557	774	......	2.28	5,170
454	65	27	13	9,852	1.2	910	......	1,386	......	$ 407	4.23	3,939
430	75.5	30	20	12,535	1.7	1,633	773	1,503	1,269	......	2.48	4,591
385	83	54.5	26.5	15,582	3.3	2,916	786	5,058	......	2,430	4.02	5,523
433	84	50.8	13	15,425	1.5	965	759	1,235	236	......	2.64	3,899
464	85.9	36.7	11	8,360	2.0	1,846	1,200	2,359	375	......	1.85	8,309
363	87.5	57.3	16.7	10,007	1.9	1,473	......	1,353	2	....	3.04	4,647
445	91	48	22.5	13,932	2.3	2,552	794	4,136	......	2,148	3.27	5,909
394	91	31	18	10,658	2.0	2,147	350	2,607	......	365	2.42	6,252
393	93	40.8	13	14,824	2.2	1,735	907	3,471	......	217	3.61	7,118
457	100	42	15.5	11,352	1.0	1,702	405	1,532	1,512	......	1.72	5,304
403	100	44.5	18	13,825	1.3	1,193	973	1,877	620	......	3.28	3,938
410	100	24.5	12.5	10,220	1.1	1,135	190	823	327	......	2.94	4,836
438	100	40.1	13.5	12,072	2.8	1,632	1,857	2,559	479	......	2.54	6,376
460	100	49	13	14,341	1.3	1,247	945	2,072	......	171	3.26	5,153
456	100	44	15	6,860	2.0	1,534	350	1,284	135	......	1.77	5,161
362	100	49	14	8,644	1.8	1,746	966	1,330	1,652	......	2.53	7,050
376	100	38	12.5	7,950	1.4	2,039	1,017	2,876	827	......	2.94	8,461
371	100	55.7	14	13,018	2.1	1,897	679	1,825	460	......	2.07	7,614
434	104	34	15.5	5,542	1.3	1,461	908	1,246	917	......	2.90	5,295
449	105	47.3	14.5	13,694	1.8	2,188	1,217	2,823	440	......	2.50	7,678
367	106	45	13.5	10,190	1.5	2,221	550	1,400	1,661	......	1.90	7,499
440	108	32	13	8,910	1.8	1,920	564	1,707	678	......	1.93	8,083
386	108	43	14	11,902	1.3	2,530	270	2,757	392	......	2.17	9,174
443	110	55.5	17.5	7,693	2.2	1,580	605	2,041	862	......	2.58	4,871
429	110	50.6	23	19,462	1.9	3,738	2,764	3,989	2,396	......	2.26	7,392

TABLE 55 (*continued*)

Farm no.	Acres operated	Acres of crops	Number of cows	Average total capital	Man equivalent	Milk sales	Crop sales	Farm expenses	Plus labor income	Minus labor income	Cow cost of milk per hundredweight	Pounds of milk produced per cow
399	110	41.8	16.5	$ 9,669	2.5	$1,752	$ 198	$2,232	...	$ 247	$2.98	5,626
381	110	43	13.5	11,824	1.9	1,965	12	2,210	$ 566	...	3 50	7,253
372	110	57.3	13.5	11,594	1.0	1,607	130	1,197	1,132	...	1 93	6,221
441	110	37.5	13.5	8,642	2.3	1,697	644	1,806	518	...	2 05	6,718
358	111	29.2	18.5	9,438	2.2	3,723	...	2,484	431	...	1 47	9,358
388	112	59.7	15	9,248	2.6	1,898	230	2,877	...	829	2 7	6,782
446	112	54.3	20	18,106	2.5	2,749	565	4,590	...	740	3 63	7,810
426	113	47	16	11,692	1 2	985	496	1,732	...	716	3 76	3,306
353	115	32.5	19	12,567	1.2	2,668	75	1,642	362	...	1.83	7,387
396	116	58.5	28.5	20,914	2.1	4,855	446	4,262	723	...	2 19	7,267
447	116	42 5	25	20,706	2.6	2,737	762	3,109	899	...	2.22	6,159
463	125	84.2	15	10,214	1.6	830	443	726	769	...	1 49	4 111
458	125	80	10.5	19,504	2.9	1,587	11,157	8,915	6,551	...	3 07	7,906
451	125	55	21	14,212	2.2	2,465	240	3,347	...	127	2.78	6,112
455	125	76	19	16,022	3.3	2,049	295	2,641	...	431	4 00	5,375
408	126	51.5	20	17,478	1.7	1,153	960	1,836	...	316	3 43	3,220
427	128	51	24.5	12,995	2.2	3,384	...	2,668	460	...	2 62	7,483
435	130	37.5	19	14,038	2.8	3,253	125	3,221	...	427	1.99	8,560
423	130	73.8	20.5	16,387	2.1	2,561	661	3,718	491	...	2 51	6,309
432	133	54	17	12,464	2.5	1,718	1,116	2,296	215	...	3.32	4,465
395	135	39.9	17	15,814	1.6	1,473	124	2,937	...	607	3.95	5,151
450	135	41	18	12,114	2.0	2,036	250	1,958	...	629	4.03	5,241
370	135	55 7	16.5	11,250	2.5	1,271	608	2,131	...	622	4 36	3,922
436	135	84.7	10.5	25,680	2.2	1,638	1,500	2,623	1,176	...	1.64	9,354
401	135	51	20	18,860	2.3	2,490	575	2,371	1,469	...	2.26	6,216
349	136	53	28	11,194	2.5	3,860	716	6,518	...	951	2.59	7,281
369	137	68.5	22.5	18,861	2.2	1,968	1,950	5,017	...	373	2.71	4,840
420	140	46	22	16,912	2.0	1,554	950	1,855	309	...	2.84	3,721
425	140	67.5	23.5	13,232	2.0	3,505	1,313	2,014	2,429	...	2.01	6,240
389	145	80	25.5	19,826	2.3	2,600	950	3,918	...	1,110	3.18	5,162
394	147	56.5	17.5	9,027	1.9	2,390	814	2,226	1,456	...	2.03	6,674

415	147	43.5	18.5	8,500	1.8	1,931	556	1,549	1,385	......	2.03	5,536
359	148	45	20.5	4,873	2.0	1,547	90	1,939	......	634	2.90	3,571
411	150	45.5	22.5	12,550	1.5	2,669	222	2,243	349	......	2.00	6,989
365	150	80	13	13,064	1.5	1,883	500	1,236	599	......	2.27	7,790
379	150	84.8	35	16,774	3.3	3,528	1,583	5,797	2,287	......	2.87	5,325
345	150	68.5	25	23,876	2.8	2,856	385	3,143	......	768	3.37	6,173
368	150	54	21	12,978	2.3	2,568	798	5,152	......	1,183	2.78	6,980
422	150.8	47	21	37,090	3.1	3,781	555	8,977	......	5,420	4.46	7,734
419	153	62.5	14.5	21,599	2.0	2,562	3,015	3,223	3,279	......	2.30	10,008
387	160	65.5	23.5	17,734	2.0	2,887	1,068	2,434	838	......	2.35	5,990
452	160	63.5	16	8,435	1.9	1,356	900	1,835	552	......	2.87	4,433
402	160	61	26	17,900	2.2	3,422	1,019	3,768	1,079	......	2.03	6,976
461	163	73	27.5	19,297	2.3	2,990	4,704	4,923	2,028	......	2.80	5,613
424	165	51.2	32.5	29,690	3.7	5,388	630	7,233	......	923	2.29	8,253
444	165	74	25	15,878	4.6	3,621	700	8,704	......	2,218	2.22	8,221
462	165	105	29.5	30,543	2.9	2,558	4,051	9,182	......	346	3.15	3,777
390	165	53	19	36,228	2.6	3,966	......	5,885	......	1,920	3.38	11,458
377	170	56	22	14,484	2.2	3,676	1,040	3,866	2,060	......	1.84	8,594
465	170	50.9	16.5	15,549	2.4	2,532	1,144	3,002	629	......	2.25	6,107
407	174	80	27	12,808	2.0	3,402	1,860	4,112	1,476	......	2.40	6,813
351	175	57	31.5	18,280	3.0	4,891	520	3,247	1,079	......	2.76	5,578
405	180	62.5	20.5	21,954	2.8	2,466	2,996	3,696	2,446	......	3.56	6,827
366	182	79.5	33	17,474	3.1	4,271	......	5,541	......	2,006	2.54	6,604
412	190	54	20	14,836	2.0	2,026	1,999	2,227	1,331	......	2.03	5,638
391	190	85.7	27	17,532	2.4	3,220	482	2,588	426	......	1.72	6,001
375	190	51	25	17,133	1.5	1,929	670	2,169	628	......	2.54	4,604
431	193	59	26	10,070	3.5	2,727	1,185	5,800	......	1,240	3.17	5,123
459	195	67	24	26,162	2.4	2,690	362	4,149	......	657	3.14	6,722
378	197	86.3	22.5	17,032	2.1	3,763	966	3,663	267	......	2.04	9,056
374	198	46.8	15	8,192	2.9	1,468	758	3,100	......	861	2.51	5,443
360	200	70.2	30	10,228	2.1	2,559	......	2,119	198	......	2.34	4,319
439	204	40.5	21	18,188	1.6	2,491	261	3,370	48	......	2.55	6,819
361	204	73.5	40	29,445	4.2	5,154	......	6,945	2,231	......	2.84	6,732
418	205	68	30.5	23,818	3.5	2,378	1,172	5,767	......	2,685	3.08	4,041
404	210	100	32	22,364	3.2	3,702	4,927	8,041	......	291	2.50	5,917
421	213	45	13.5	13,714	2.1	1,558	50	1,935	......	133	2.06	6,121
428	219	67.5	26.5	15,978	3.3	4,413	3,751	4,443	3,167	......	1.54	7,404
364	220	62	24.5	10,546	1.7	2,809	285	2,125	1,888	......	1.19	6,487
453	224	109	27	20,717	2.1	3,578	431	2,357	630	......	1.80	6,968
350	225	82	28.5	18,338	3.0	6,758	300	5,693	915	......	1.81	11,238

TABLE 55 (*concluded*)

Farm no.	Acres operated	Acres of crops	Number of cows	Average total capital	Man equivalent	Milk sales	Crop sales	Farm expenses	Plus labor income	Minus labor income	Cow cost of milk per hundredweight	Pounds of milk produced per cow
409	233	95.5	32	$39,518	5.2	$ 4,185	$7,216	$ 8,996	......	$1,086	$2.89	7,112
437	240	80	24	21,465	2.5	2,314	1,648	3,629	$ 804	......	2.71	5,617
448	246	135	26.5	36,677	4.0	3,805	3,399	8,206	2,331	......	1.98	9,063
442	249	93.5	42.5	38,781	3.9	4,500	3,198	6,192	3,087	......	1.72	6,233
398	257	94.5	25.5	19,572	2.4	2,174	2,539	2,818	1,193	.....	3.85	4,537
373	260	76	39	22,160	2.2	4,985	16	3,915	......	241	2.35	6,673
347	276	81.5	30	13,742	2.2	3,063	80	3,854	......	686	3.19	5,490
416	287	142	40.5	22,986	3.0	3,593	2,244	5,001	880	......	3.09	4,873
348	288	116	23.5	15,910	2.2	1,984	20	1,916	......	834	3.99	3,938
356	297	125	38.5	16,425	2.5	1,238	329	2,592	......	1,686	7.00	1,556
382	300	117.5	50	29,210	5.4	10,554	610	12,232	......	1,732	2.17	8,497
383	302	81.6	32	22,397	2.3	5,413	1,298	4,771	371	......	2.35	8,708
413	307	98	56.5	24,258	3.8	5,532	1,600	6,346	......	713	2.94	4,217
384	310	121.5	37.5	36,280	3.2	5,359	1,600	4,828	3,044	......	1.57	7,628
346	326	50.1	29.5	12,054	1.8	3,221	....	3,428	......	673	2.66	5,571
354	334	87	37.5	13,538	3.9	5,162	.....	5,577	......	2,026	2.41	7,314
357	360	72	24	8,490	1.5	3,102	100	2,687	795	......	2.00	6,781
352	400	176	58.5	38,056	2.5	6,030	573	5,071	833	......	2.23	5,025
400	550	150	39.5	43,662	3.0	2,967	1,267	7,986	1,017	......	3.48	4,623
355	643	144	39	26,130	2.4	3,217	150	4,338	......	1,961	3.43	3,516

The original data for each farm are given, so that if desired, in teaching farm management in vocational schools or colleges, practice exercises in studying relationships can be assigned. The following studies of table 55 are suggested:

1. Relation of acres operated, to number of cows, man equivalent, total capital, labor income, cost of milk, and acres of crops per man.

2. Relation of number of cows per farm, to labor income and to cost of milk production.

3. Relation of acres operated, to farm expenses per acre and per $100 of receipts from milk and crops.

4. Relation of pounds of milk produced per cow, to labor income, size of herd, cost of milk, and milk produced per man.

5. Relation of cost of milk production, to labor income.

Other similar studies can be made from table 55 and will teach the student both the method of doing the work and the farm-management principles involved.

The same can be done with tables 89 and 90 in Bulletin 433 of this experiment station, and tables 78 and 79 in Bulletin 438.

SUCCESSFUL FARMS

A discussion of four successful farms producing Grade A milk and cash crops was given in another bulletin of this series.[10] The data for some farms producing Grade B milk and cash crops, whose farm labor incomes are over $2000, are shown in table 56. There are some farmers who are almost always prosperous. The degree of their prosperity varies with price and production conditions, but their businesses are so well organized

TABLE 56. BUSINESS FACTORS FOR SOME SUCCESSFUL FARMS WITH CASH CROPS, FOR THE YEAR ENDING APRIL 30, 1922

Farm no.	461	429	442	428
County	Madison	Madison	Chenango	Madison
Village	Hamilton	Hamilton	Sherburne	Hubbardsville
Operator's labor income	$1,054*	$1,477*	$3,487*	$3,167
Landlord's return on investment (per cent)	10.8	10.4	3.0	....
Cost of milk per 100 pounds	$2.80	$2.26	$1.72	$1.54
Price received for milk	$2.03	$2.24	$1.91	$2.30
Gain or loss per cow:				
Gain	....	....	$10.73	$55.09
Loss	$41.45	$1.57	....	....
Size of business:				
Acres operated	163	110	249	219
Acres of crops	73	50.6	98.5	67.5
Number of cows	27.5	23.0	42.5	26.5
Number of men, including operator	2.3	1.9	3.9	3.3

* The total farm income above interest was $2028 on farm no. 461, $2396 on farm no. 429, and $3087 on farm no. 442.

[10] Bulletin 433 of this experiment station, page 137.

TABLE 56 (*concluded*)

Farm no.	461	429	442	428
County	Madison	Madison	Chenango	Madison
Village	Hamilton	Hamilton	Sherburne	Hubbardsville
Size of business (*concluded*):				
Capital:				
Landlord	$16,828	$17,026	$20,000	....
Operator	$2,469	$2,436	$18,781	$15,978
Hundredweight of milk sold per farm	1,476	1,668	2,354	1,916
Type of business:				
Milk receipts	$2,990	$3,738	$4,500	$4,413
Crop sales	$4,704	$2,764	$3,198	$3,751
Potatoes	$100	$26	....	$30
Cabbage	$2,268	$1,640	$2,812	$750
Hay	....	$224	....	$221
Field beans	....	$64	....	....
Market peas	$2,250	$810	....	$2,750
Wheat	$86	....	$226	....
Barley	....	....	$75	....
Pop corn	....	....	$20	....
Pumpkins	....	....	$65	....
Per cent of cows freshening from September to December, inclusive	48.1	40.0	76.6	46.2
Per cent of cows less than four years old	25.0	12.0	35.0	18.9
Acres of crops per animal unit	1.8	1.7	1.4	2.0
Rates of production:				
Pounds of milk produced per cow	5,613	7,392	6,233	7,404
Crop yields:				
Corn for the silo (tons)	15.8	16.6	13.8	16.4
Hay (tons)	1.2	2.4	1.7	1.8
Potatoes (bushels)	130	102	100	200
Cabbage (tons)	9.6	12.8	18.5	7.5
Oats (bushels)	40	36	40	33.3
Barley (bushels)	....	....	55	....
Wheat (bushels)	25	....	30	....
Market peas (bushels)	250	144	....	250
Feeding:				
Pounds of concentrates per cow	2,695	1,957	2,071	1,358
Pounds of silage and other succulent feed per cow	11,236	14,609	8,282	9,358
Pounds of dry forage per cow	2,327	2,522	3,012	3,019
Per cent of protein in grain concentrates	22.2	21.2	14.1	21.0
Price per ton for concentrates	$43.02	$39.73	$30.70	$41.39
Acres of crops grown:				
Corn for the silo	13	11	12	8
Oats	10	4	7	9
Other hay	30	21	59	42
Potatoes	1	1	1	0.5
Cabbage	8	5	4	4
Wheat	....	....	5	....
Market peas	4	3.5	....	4
Barley	....	....	7	....

or so skillfully managed that adversity does not sufficiently affect them to prevent making the interest on their investment.

Farm no. 429 is a share-rented farm with good buildings and good land, but is small, comprising only 110 acres. The livestock included 23 cows, 4 heifers, 1 bull, and 3 horses. From this farm 14 tons of hay were sold for $224, 64 tons of cabbage for $1640, and 504 bushels of peas for $810. The total crop sales were $2764, of which the landlord received $1382. The milk sales were $3738, of which the landlord received $1869. The landlord's expenses were $2136; his net income was $1770 on an investment of $17,026, or 10.4 per cent on the investment. The tenant's capital was $2436. He hired one elderly man for five months for his board, and one man for five months for $50 cash and board, and paid one-half of the pea-picking charges of 30 cents a bushel. His total expenses were $1853, and his labor income above 5 per cent on $2436 was $1477. Of this amount, cash living expenses were $750. At this rate the operator's gain was about $700 for the year. The primary reasons for the success of the business are that the farm was productive, the cows were good and the feeding of them was economical, the prices and crops of peas and cabbage were good, the price for milk was above the average, and the work was accomplished economically. Without the advantage of good prices, neither tenant nor landlord would have done so well.

Farm no. 461 is also a half-share farm, representing $16,828 capital for the landlord and $2469 for the tenant. The tenant's labor income was $1054 and the landlord's return on capital was 10.8 per cent. On this farm the landlord furnished 25 purebred cows and the tenant furnished 3. Each had a half share in the young cattle, and each received half of the milk and crop sales.

The chief reasons for the success of this business were the good prices and the good crops of cabbage and peas. The production per cow was low, 5613 pounds; the feeding was liberal, but the herd was young. When a large amount of cultivated cash crops are produced, the landlord benefits more than the tenant under the half-share arrangement, because the chief expense in production is labor. An ambitious tenant gives a landlord half of the cultivated cash crops only until he has enough money to purchase a farm. This tenant purchased a farm in 1923. A landlord is fortunate in being able to rent a good dairy and crop farm for half of the proceeds.

Farm no. 428 made a labor income of $3167 on 219 acres with a total capital of $15,978. A total of 27 cows, producing an average of 7404 pounds of milk per cow, were kept. Crop sales were: cabbage, 24 tons from 4 acres, $750; peas, 1000 bushels, $2750; and hay, $221. The average price received for milk was $2.30 a hundredweight. Of the cows, 46 per cent freshened from September to December. A fall dairy of good cows, and large crop sales, were the leading features of the business.

Farm no. 442 is a large farm combining a herd of about 90 head of registered Holsteins, with cash-crop production. There were 98 acres of crops, with sales as follows: wheat, $226; barley, $75; pop corn, $20; cabbage, $2812; and pumpkins, $65. The appreciation on cattle and the value of calves at birth was $2406 and the milk sales were $4500. The production

of milk was 6233 pounds per cow. Some sirup was sold, and some work was done on the road. The man equivalent was 3.9, the capital was $38,781, and the labor income was $3087.

Recent publications on dairy farming by the same author, from the New York State College of Agriculture, are:

Calculating the cost of milk production. Reading Course Lesson for the Farm, No. 142. 1919.

An economic study of dairying on 149 farms in Broome County, New York. Cornell Univ. Agr. Exp. Sta., Bulletin 409. 1922.

Relation of the composition of rations on some New York dairy farms to the economics of milk production. Cornell Univ. Agr. Exp. Sta., Memoir 64. 1923.

Economic studies of dairy farming in New York. I. Condensery milk without cash crops. Cornell Univ. Agr. Exp. Sta., Bulletin 421. 1923.

An economic study of dairying on 163 farms in Herkimer County, New York. Cornell Univ. Agr. Exp. Sta., Bulletin 432. 1924.

Economic studies of dairy farming in New York. II. Grade A milk with and without cash crops. Cornell Univ. Agr. Exp. Sta., Bulletin 433. 1924.

Economic studies of dairy farming in New York. III. Grade B milk with alfalfa roughage. Cornell Univ. Agr. Exp. Sta., Bulletin 438. 1925.

Bulletin 442

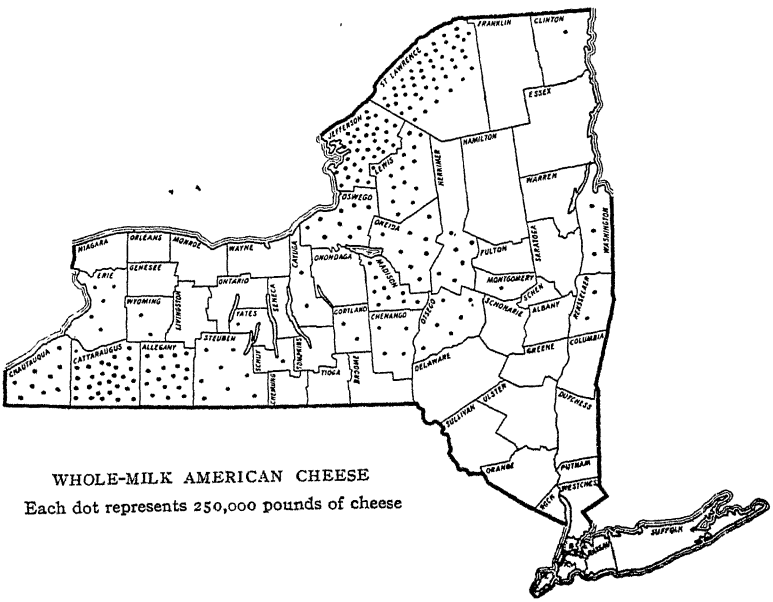
September, 1925

Economic Studies of Dairy Farming in New York. V

Cheese-Factory Milk

E. G. Misner

In cooperation with the Bureau of Agricultural Economics of the United States Department of Agriculture



WHOLE-MILK AMERICAN CHEESE
Each dot represents 250,000 pounds of cheese

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CONTENTS

ECONOMIC STUDIES OF DAIRY FARMING IN NEW YORK. V. CHEESE-FACTORY MILK

E. G. MISNER [1]

This bulletin is the fifth of a series reporting the financial conditions and organization of farms following different systems of dairy farming.[2] The system of farming reported in this bulletin is the production of milk for factories making Limburger and whole-milk Cheddar cheese, in Jefferson County. Except in some years when hay is sold as a cash crop, the dairy is the exclusive source of income on the farms studied.

REGIONAL CONDITIONS

The farms included in this report are situated in the vicinity of La Fargeville, a small village with a population of about 300.

The climate at Cape Vincent, Jefferson County, for the twelve months covered by this study, was as shown in table 1.

The soils of the farms studied were Vergennes loam, Vergennes silt loam, Vergennes clay, Rodman stony sand, and Cossayuma sandy loam.[3]

The topography of the area ranges from flat to very gently rolling. The elevation is between 260 and 480 feet above sea level. The average elevation of the 67 farms was 394 feet. The area is a part of the St. Lawrence River valley. Transportation for farm products is provided by the New York Central Railroad.

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[1] The writer was assisted in the field by M. J B. Ezekiel, W. G. Meal, and J. J. Vernon. The information was gathered thru a cooperative agreement between the Department of Agricultural Economics and Farm Management of the New York State College of Agriculture at Cornell University, Ithaca, New York, and the Divisions of Farm Management and Cost of Production, Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C.

The following farmers cooperated by furnishing information for the crop year of 1921:

Operators: Frank Allen, Gerald Backus, George Baldwin, F. W. Barton, C. R. Bates, F. E. Bellinger, A. P. Bretsch, H. S. Bretsch, Peter Cardiff, Edward Cavanaugh, Earl Clark, R. D. Cratsenberg, Charles DeRosia, E. G. Dintelman, Alfred H. Dorr, Charles Dorr, C. L. Dorr, Wilbur Eager, William Eckert, George E. Eddy, C. Ellingworth, Carl Fults, J. S. Getman, F. A. Gibbons, Wayne S. Gibson, Albert A. Haas, Edwin Hall, Frank Haller, Matthew Haven, John Hearns, Edwin Kirby, C. J. Landon, A. L. Lingenfelter, H. J. Loehr, Edward Ludlow, S. D. McCayar, Ernest McNickle, Joseph Maxdorf, Clarence Micheau, I. B. Mitchell, J. J. Murphy, W. Nellis and son, Andrew Oberton, I. D. Orvis, F. D. Percy, G. H. Quartz, W. E. Robbins, F. J. Schneider, Clifford and Frank Schryver, Francis Shullette, Burton and M. Simmons, Charles Smith, C. R. Smith, E. F. Snell, Hugh W. Steele, George Stevens, Mrs. Belle Tamplin, E. A. Timmerman and sons, F. A Timmerman, G. C. Timmerman, Jacob Vogt, George Wagner, Edward Weaver, Glen Weed, Fred Wetterhahn, Hanley Williams, C. J. Wrape.

Landlords: A. K. Adams, Claude Anable, A. G. Baltz, F. H. Barlow, Clara Calkins, Elizabeth Dintelman, D. H. Dorr, Mrs. Petina Eckert, C. I. Fults, F. I. Gailey, Frank Gibbons, James Hagan, W. J. Hagan, William Haller, William Harder, William Hardy, Mrs. Harmon, William Heyl, B. E. Holloway, C. P. Knight, J. Lingenfelter, Mrs. Dell McNickle, George Miller, Mrs. Mitchell, J. S. Newton, L. E. Ostrander, Fred Resch, W. Robinson, George Schaefer, D. A. Schall, William Schnauber, W. B. Shoat, Smith Bros., Mrs. C. I. Snow, O. M. Snow, R. W. Steele, Mrs. Sarah Swanton, Leland Tallman, Mrs. Vebber, Martin Vogt, Cornelia Walts, Ernest Wetterhahn.

[2] The preceding bulletins in this series are:

Economic studies of dairy farming in New York. I. Condensery milk without cash crops. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bulletin 421. 1923.

Economic studies of dairy farming in New York. II. Grade A milk with and without cash crops. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bulletin 433. 1924.

Economic studies of dairy farming in New York. III. Grade B milk with alfalfa roughage. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bulletin 438. 1925.

Economic studies of dairy farming in New York. IV. Grade B milk with cash crops and mixed hay roughage. By E. G. Misner. Cornell Univ. Agr. Exp. Sta., Bulletin 441. 1925.

[3] Soil survey of Jefferson County, New York. U. S. Agr. Dept., Soils Bur., 1913.

TABLE 1. PRECIPITATION AND TEMPERATURE AT CAPE VINCENT, JEFFERSON COUNTY

	Precipitation		Temperature	
	Inches	Per cent of normal	Actual (degrees F.)	Per cent of normal
1921:				
May	2.36	62	55.0°	104
June	2.13	67	65.8°	104
July	1.91	67	77.6°	112
August	3.33	116	68.2°	101
September	2.35	78	60.6°	100
October	2.46	73	....	....
November	2.80	108	34.4°	92
December	2.08	78	24.7°	100
1922:				
January	1.86	79	15.8°	85
February	2.27	105	21.6°	133
March	3.75	187	31.4°	113
April	3.98	147	42.5°	103
Total or average	31.28	93	45.2°	104

AGE, TENURE, AND WAGES

Of the 67 farm operators, 10 had attended high school for an average of 1.7 years, 1 had attended normal school for 3 years, and 1 had attended college for 0.5 year. The average age of the farmers was 42 years.

Jefferson County is a region where a large proportion of the farm operators are share tenants. On the 67 farms studied, 29 of the operators owned their farms, 36 were share tenants, and 2 were cash tenants. Of the 29 owners, 16 had been tenants sometime during their farming career.

The employment history of the present operators is shown in table 2, and the preceding tenure status in table 3. The average age at which the 29 operators acquired their farms was 33 years.

TABLE 2. EMPLOYMENT HISTORY OF 66 FARM OPERATORS

	Owner of present farm but never owner of other farms	Owner of other farms before becoming or while owner of present farm	Share tenants*	Cash tenants
Total number of this tenure status	25	4	35*	2
Number that never had been tenants	11	2	....	....
Number that had been tenants on present farm but never on other farms	3	....	11	1

TABLE 2 (*concluded*)

	Owner of present farm but never owner of other farms	Owner of other farms before becoming or while owner of present farm	Share tenants*	Cash tenants
Number that had been tenants on other farms but never on present farm	9	1	....	....
Number that had been tenants both on other farms and on present farm	2	1	24	1
Total number that had worked as hired men on farms	22	2	29	1
Number that had worked as hired men on home farm but not on other farms	11	....	11	1
Number that had worked as hired men on other farms but not on home farm	6	2	12	....
Number that had worked as hired men both on other farms and on home farm	5	....	6	....
Number that had never worked as hired men on farms but had been engaged in other occupations	2	1	4	1
Number that had neither worked as hired men on farms nor been engaged in other occupations	1	1	2	....
Number that had worked as hired men on farms and had been engaged in other occupations	5	....	12	....
Number that had worked as hired men on farms but had never been engaged in other occupations	17	2	17	1

* On one farm the record was taken from the landlord, and no history was given.

TABLE 3. PRECEDING TENURE STATUS OF PRESENT OPERATORS

	Owners	Share tenants*	Cash tenants	All operators
Number of farms	29	35*	2	66*
Average age of operator (years)	46	39	32	42
Average age at which operator began present status (years)	33.	....	....	....
Average years in present status	12.7	....	....	....
Tenant on present farm:				
Number of farmers	6	35	2	43
Average age when farmer began tenancy (years)	25	34	30	33
Average years in such status	8.7	5.1	3.0	5.5

TABLE 3 (*concluded*)

	Owners	Share tenants*	Cash tenants	All operators
Tenant on other farms:				
Number of farmers	13	24	1	38
Average age when farmer began tenancy (years)	25	30	25	28
Average years in such status	8 7	7.7	9 0	8 1
Hired man at home:				
Number of farmers	16	17	1	34
Average age when farmer began as hired man (years)	16	16	16	16
Average years in such status	9 2	9 0	9 0	9.1
Hired man away from home:				
Number of farmers	13	18	.....	31
Average age when farmer began as hired man (years)	18	18	.....	18
Average years in such status	5 6	6.8	.....	6.3
Other occupations:				
Number of farmers	8	16	1	25
Average age when farmer began such occupations (years)	23	21	17	22
Average years in such status	6.9	8.2	8.0	7.8

* Excluding one farm for which no history was given.

The variation in the estimates placed on their time by farm operators are given in table 4. The average value placed on their time for twelve months was $846, or $71 per month.

TABLE 4. VARIATIONS IN ESTIMATES PLACED BY 67 FARM OPERATORS ON THE VALUE OF THEIR TIME FOR TWELVE MONTHS

Value of operator's labor	Number of farms	Per cent of total farms
$ 400	1	1 5
480	3	4.5
540	3	4.5
600	12	17.9
620	1	1.5
700	3	4.5
720	5	7.4
750	1	1.5
756	1	1.5
800	4	6.0
840	2	3.0
888	1	1.5
900	9	13.4
936	2	3 0
960	5	7.4
1,000	3	4.5
1,056	2	3.0
1,074	1	1.5
1,200	6	8.9
1,300	1	1.5
3,000	1	1.5
Total	67	100.0

TABLE 5. LABOR ON 67 LA FARGEVILLE FARMS

	Number of farms using	Months worked			Value of unpaid labor		Total wages		Average per month worked	
		Total	Per cent	Per farm	Total	Average per month	Cash	Board	Cash	Value of board
Operator's wife:										
Unpaid	41	115.5	15.7	2.8	$ 5,972	$51.71	...	...		...
Operator's sons:										
Paid	3	31	4.2	10.3	..	.....	$1,310	$ 484*	$42.26	$25.47
Unpaid	26	264	35.9	10.2	14,451	54.74	......	..	.	...
Operator's daughters:										
Unpaid	11	31.8	4.3	2.9	1,502	47.23	.	..	..	...
Operator's other relatives:										
Paid	1	11	1.5	11	...	...	660	308	60.00	28.00
Unpaid	13	119.6	16.3	9.2	6,369	53.25	....		.	.
Landlord:										
Unpaid	1	0.7	0.1	0.7	65	92.86	....			..
Hired men, without board	2	12	1.6	6	..	.	701	.	58.42	
Hired men, with board	25	134.5	18.3	5.4	..	..	4,992	2,716	37.12	20.19
Hired men, board only	1	2	0.3	2.0	.	.	.....	100		50.00
Hired men, by day:										
Without board	11	6.9	0.9	0.6	...		580	.	84.06	.
With board	14	6.2	0.9	0.4	..		393	113	63.39	18.23
Total labor, except operator	67	735.2	100	11	$28,359	$53.35	$8,636	$3,721	$42.84	$21.55
Operator	66	791	...	12	$56,098	$70.92	....	.	.	..
Son's share as operator	1	12	...	12	540	45.00	..		.	..
Hired man's share as operator	1	1		1	74	74.00	..		.	..
Total for 12 month's time, operator	67	804	.	12	$56,712	$70.54	..	.	......	..
Man equivalent	....	.	.	1.92	...		..	....	..	....

* Board was furnished for 19 months on 2 farms.

The usual practice of hiring help in this region is to hire single men and furnish board. The average cash wages paid to such help on 25 farms was $37.12 per month, and the average cash value of the board furnished, excluding that part furnished by the farm, was $20.19 per month, making a total of $57 per month (table 5). On two farms men were hired by the month with no board furnished, the wages being $58 per month.

Of the total months of labor, 52.2 per cent was time spent by the operator, 37.2 per cent was time spent by members of the operator's family, and 10.6 per cent was time spent by other persons. The average number of persons equivalent to men, computed on a yearly basis (man equivalent) was 1.92.

FARM CAPITAL

The average size of the 67 farms was 203 acres, with 109 acres, or 54 per cent of the total, in crops, and an equivalent of 71 acres of pasture per farm (table 6). A larger share of the farm is crop land in this region than in any of the areas reported in the preceding bulletins in this series. The reason for this is that the topography of the area is level or gently rolling. Of the pasture land, 20 acres per farm were considered by the farmers to be tillable.

TABLE 6. AVERAGE SIZE OF 67 FARMS

	Average acres per farm	Per cent of total acres
Crop land	108.7	53.5
Woods pastured *	17.9	8.8
Rotated pasture	8.8	4.3
Permanent pasture tillable	20.1	9.9
Other permanent pasture	36.1	17.8
Woods not pastured	2.4	1.2
Farmstead, roads, and so forth	9.2	4.5
Total	203.2	100.0

* Equivalent to 6.1 acres of open pasture.

The average total capital for the La Fargeville farms was $13,909 per farm, of which 76.9 per cent was in real estate, 14 per cent was in livestock, 8.3 per cent was in machinery, and 0.8 per cent was in feed and supplies (table 7).

TABLE 7. AVERAGE CAPITAL FOR 67 FARMS

	Value per farm	Per cent of total
Real estate	$10,691	76.9
Livestock	1,944	14.0
Machinery	1,161	8.3
Feed and supplies	113	0.8
Total	$13,909	100.0

The farms had an average value of $52.62 per acre. The value of the crop land was $39.71 per acre; of the pasture land, $22.77 per acre; and of the woodland, $15.82 per acre. The distribution of the real-estate capitalization in this area is shown in table 8:

TABLE 8. DISTRIBUTION OF FARM REAL-ESTATE CAPITAL

	Value per farm	Per cent of total
Dwelling no. 1	$1,607	15.0
Dwelling no. 2	126	1.2
Cattle barn	1,842	17.1
Barn no. 2	396	3.7
Other buildings	582	5.4
Total buildings	$4,553	42.4
Orchard	$ 2	....
Crop land	4,318	40.2
Pasture land, except woods pastured	1,480	13.7
Woodland	321	3.0
Other land	74	0.7
Total land	$6,195	57.6
Total value of farm (land and buildings)	$10,748	100.0

The average value of the operator's dwelling was $1607 per farm; of the cattle barns, $1842 per farm; and of the other buildings, $1104; making a total of $4553 in buildings, or 42.4 per cent of the total farm capital. The remaining $6195, or 57.6 per cent of the total, was in land. The variation in the size of farms is shown in table 49 (page 46).

FARM RECEIPTS

The total receipts per farm were $2002, comprising: $151, or 7.5 per cent, from crops sold; $310, or 15.5 per cent, from livestock sold; $1299, or 64.9 per cent, from milk sold (including both cash and certificates of indebtedness of the Dairymen's League Cooperative Association, Inc.); $15, or 0.8 per cent, from an increase in inventory; and $227, or 11.3 per cent, from miscellaneous sources. The data are given in table 9:

TABLE 9. AVERAGE RECEIPTS PER FARM

	Average per farm	Per cent of total
Crops sold	$ 151	7.5
Livestock sold	310	15.5
Milk sold:		
Cash	1,266	63.2
Certificates of indebtedness	33	1.7
Increase in inventory	15	0.8
Miscellaneous	227	11.3
Total	$2,002	100.0

CROPS

The crops grown, the yields per acre, and the receipts from sales of crops, are given in table 10:

TABLE 10. CROPS RAISED ON 67 FARMS

Kind of crop	Acres	Total yield	Unit	Operator's sales		Landlord's sales	
				Amount	Value	Amount	Value
Corn for grain	32	843	Bushels	...	...	...	...
Stover from corn for grain	...	61	Tons	...	...	...	...
Corn for the silo	346	2,849	Tons	...	...	...	...
Corn for the silo, surplus	4.5	25	Tons	8	$26	...	...
Grain from corn for the silo	...	1,075	Bushels	...	...	...	...
Corn for fodder, cured	25.5	97	Tons	...	...	...	...
Sweet corn fed green	2.5	8	Tons	...	...	...	...
Other corn fed green	12	52	Tons	...	...	...	...
Oats	1,394	27,897	Bushels	848	430	550	$288
Oat straw	...	684	Tons	6.5	32	1.5	7
Oats and barley	347	7,358	Bushels	102	82	63	63
Oat and barley straw	...	178	Tons	5	25	...	...
Barley	38	452	Bushels	...	...	...	...
Barley straw	...	20	Tons	...	...	...	...
Buckwheat	6	79	Bushels	...	...	...	...
Rye	6	100	Bushels	...	...	...	...
Rye straw	...	8	Tons	...	...	...	...
Winter wheat	20	190	Bushels	...	...	...	...
Spring wheat	39	321	Bushels	25	30	14	19
Wheat straw	...	23.5	Tons	...	...	...	...
Oats, barley, and buckwheat	30	625	Bushels	...	...	...	...
Oat, barley, and buckwheat straw	...	10	Tons	...	...	...	...
Oats, barley, and peas	38	1,125	Bushels	...	...	...	...
Oat, barley, and pea straw	...	35	Tons	...	...	...	...
Oats, speltz, and wheat	22	700	Bushels	...	...	...	...
Oat, speltz, and wheat straw	...	11	Tons	...	...	...	...
Timothy seed	...	8	Bushels	8	32	...	...
Oat, barley, and wheat straw	...	10	Tons	...	...	...	...
Barley and wheat straw	...	2	Tons	...	...	...	...
Oats for hay	3	6	Tons	...	...	...	...
Buckwheat for hay	2	1.5	Tons	...	...	...	...
Oats fed green	2	6	Tons	...	...	...	...
Oats, peas, and barley fed green	1.5	10	Tons	...	...	...	...
Buckwheat fed green	2	2	Tons	...	...	...	...
Alfalfa, first cutting	12	16	Tons	...	...	...	...
Alfalfa, second cutting*	(4)	2	Tons	...	...	...	...
Alfalfa, second cutting, fed green*	(8)	8	Tons	...	...	...	...
Mixed hay (clover)	912	708.5	Tons	3.5	70	3.5	70
Mixed hay (other)	1,440	897	Tons	80.5	1,335	9.5	190
Timothy	2,465	1,733	Tons	310	5,221	54	859
Sweet clover	11	8	Tons	...	...	...	...
Swale hay	37	32	Tons	3	20	...	...
Potatoes	26.1	1,639	Bushels	144	185	15	15
Field beans	1	6	Bushels	1.5	4	1.5	4
Pop corn	1	7	Bushels	7	24	...	...
Apples	5	...	...	...	...	...	...
Garden	2	...	...	...	...	...	...
1920 oats	...	...	Bushels	...	...	150	75
1920 mixed hay (other)	...	...	Tons	50	830	...	...
1920 timothy	...	...	Tons	10	200	...	...
Total	7,285.1	...	...	...	$8,546	...	$1,590

* These acres are not included in the total acres of crops.

The average yields per acre for the more important crops were: corn for the silo, 8.2 tons; oats threshed, 20 bushels; mixed hay (clover), 0.8 ton; mixed hay (other), 0.6 ton; timothy, 0.7 ton.

The crop index for the La Fargeville area, compared with the average yield of the farm crops for New York for many years as 100, was 56. Yields for all crops except corn were very low. The low hay and grain yields were due chiefly to the dry weather during May, when only 62 per

cent of the normal amount of rain fell, and during June and July, when only 67 per cent of the normal amount fell. Inasmuch as the rainfall was heavier in August — 116 per cent of normal — the corn crop was not so badly injured by the dry weather as were the hay and the grain. The index for oats was 60 and that for hay was 49, while that for corn was 133.

The income from crop sales in this area is normally more than it was for the year under study, because in years of favorable rainfall more hay is sold.

Of the 67 farms 43 had silos, and 3 of these had two silos each. There were 38 cylindrical silos, 7 rectangular silos, and 1 octagonal silo, of the various dimensions indicated in table 11:

TABLE 11. SUMMARY OF NUMBER OF SILOS OF EACH SIZE, 43 FARMS*

Height of silos, in feet	Diameter of silos, in feet — Number of silos: 10	12	14	16	18	Total silos †
20	1	1	......	1	......	3
24	......	3	......	......	......	3
25	......	2	......	......	......	2
26	1	3	4	......	......	8
28	......	1	3	......	......	4
30	1	2	3	......	......	6
32	......	1	......	......	2	3
34	......	1	1	......	......	2
35	......	2	......	1	......	3
38	......	......	......	1	......	1
40	......	1	......	......	......	1
41	......	......	......	1	......	1
Total	3	17	11	4	2	37

* On 1 farm of the 43 farms that had silos, the size of silo was not found; 3 farms had two silos each.
† In addition to the round silos, there were seven rectangular silos of the following dimensions: 11 x 11 x 20 feet, 11 x 11 x 26 feet, 13.6 x 13.6 x 26 feet, 14 x 14 x 27 feet, 12 x 14 x 14 feet, 6 x 10 x 16 feet, 12 x 14 x 25 feet; and one octagonal silo 17 x 55 feet.

The varieties of silage corn grown on the 43 farms were as shown in table 12:

TABLE 12. VARIETIES OF CORN FOR THE SILO, 43 FARMS

Variety	Acres	Per cent
Leaming	109	31.5
Pride of the North	95.5	27.6
Luce's Favorite	49	14.2
Golden Glow	12	3.5
Improved Mastodon	12	3.5
Flint	8	2.3
Lake Erie Dent	7	2.0
90-Day Dent	6.5	1.9

TABLE 12 (*concluded*)

Variety	Acres	Per cent
Early Eureka	6	1.7
Mammoth Red Dent	6	1.7
West Branch	5	1.4
Little Dent	5	1.4
White Pearl	4	1.2
Central Pennsylvania	3.5	1.0
Early Yellow Dent	2	0.6
Bailey Dent	2	0.6
Kinds not specified	13.5	3.9
Total	346	100.0

On the 43 farms, there were grown 346 acres of corn for the silo, an average of 8 acres to the farm. Of this total, 109 acres, or 31.5 per cent, was Leaming; 95.5 acres, or 27.6 per cent, was Pride of the North; 49 acres, or 14.2 per cent, was Luce's Favorite; and the remaining 92.5 acres, or 26.7 per cent, were other varieties.

LIVESTOCK

Statements of inventories, purchases, sales, and deaths, of cattle and other livestock, appear in tables 13 and 14.

In recent years the preference of consumers and of meat dealers for western beef has resulted in very low prices for dairy cows that must be sold for beef. The placing on the market of large numbers of carcasses of animals slaughtered as a consequence of the tuberculin test has accounted in part for the preference for western meat. The result is that cows thin in flesh sell for little more than the value of the hide.

TABLE 13. APPRECIATION AND DEPRECIATION ON DAIRY CATTLE, 67 FARMS

	Cows						Heifers											
							Grade						Purebred					
	Grade			Purebred			One year or over			Under one year			One year or over			Under one year		
	Number of farms	Number of cows	Value	Number of farms	Number of cows	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value	Number of farms	Number of heifers	Value
On hand May 1, 1921 ...	66	1,181	$70,305	9	42	$3,674	53	238	$6,014	44	149	$1,955	6	15	$806	5	12	$265
Purchased during year...	13	28.5	1,341	1	2	95	6	9.5	263	2	4.5	40	1	0.5	60	1	2	35
Born during year.........	.....	.....	......	.....	.....	......	.....	...	......	50	163	364	...	.....	......	7	15	193
Heifers that became cows.	49	161	7,430	6	8	710	...	....	.	...	.		..	.	.....	....	.	..
Total..............	.....	...	$79,076	.....	.....	$4,479	.....	.....	$6,277	..	..	$2,359	.	..	$866		.	$493
Sold	48	130	$ 4,124	2	8	$ 555	5	12.3	$ 273	7	23.5	$ 260	1	0.5	$ 60	.		..
Died or killed by accident.	21	29	......	2	2	.....	4	5	..	...	..				.			
Hides sold	17	17	42	1	1	2	1	1	2	..	.....	...		.	...	.		
Heifers that became cows.	.....	.....	......	.....	..	.....	49	161	7,430	...	...	..	6	8	710	.	.	..
Used for food	18	16.5	523	..	.	..	1	0.2	7		.		..	..		..		..
On hand May 1, 1922.....	66	1,195	70,986	10	42	3,649	50	211	6,428	47	151	2,040	5	19	1,040	7	17	$425
Total.....	..	...	$75,675	.	.....	$4,206	.	...	$14,140	..	...	$2,300		.	$1,810		.	$425
Appreciation.....	....						$8,680											
Depreciation	$3,674						.....											

TABLE 13 (*concluded*)

	Herd bulls						Veals			Bull calves to be sold		
	Grade			Purebred								
	Number of farms	Number of bulls	Value	Number of farms	Number of bulls	Value	Number of *farms*	Number of veals	Value	Number of farms	Number of bull calves	Value
On hand May 1, 1921	40*	48*	$1,669	25	28	$1,829	......	......	......	2	2	$29
Purchased during year	12	13	460	5	5	113	8	46	$ 86	......	......	......
Born during year	13	14	28	1	1	15	66	919	1,593	3	3	13
Heifers that became cows	......	......	......	......	......	......	......	......	......	......	......	......
Total	......	......	$2,157	......	......	$1,957	......	......	$1,679	......	......	$42
Sold	22	21.7	$ 880	5	5	$ 282	66† { 56 43	558 390	$6,849 689	1	1	$ 8
Died or killed by accident	......	......	......	......	......	......	3	13	......	1	1	......
Hides sold	3	3	8	1	1	4	1	2	2	......	......	......
Heifers that became cows	......	......	......	......	......	......	......	......	......	......	......	......
Used for food	4	3.3	133	1	1	40	1	2	10	......	......	......
On hand May 1, 1922	41*	50*	1,567	25	28	1,875	1	2	28	3	3	114
Total	......	......	$2,588	......	......	$2,201	......	......	$7,578	......	......	$122
Appreciation	$675						$5,899			$80		
Depreciation	......						......			......		

* Including one farm that had one bull for keep.
† 56 farms sold 558 fat veals, and 43 farms sold 390 veals at birth.

TABLE 14. SUMMARY OF LIVESTOCK OTHER THAN DAIRY CATTLE, 67 FARMS

	Inventory at beginning of year			Purchases			Sales			Inventory at end of year			Died		Used for food		
	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Value	Number of farms	Number of head	Number of farms	Number of head	Value
Horses	67	264	$34,325	9	14	$1,640	9	12	$ 965	67	266	$33,660	5	5	...		...
Colts	14	19	1,515	1	1	50	...	...	...	14	18	1,650	.		...		...
Stallions	2	2	400	...	...	...	1	1	150	1	1	200	...	.	...		.
Sheep, ewes	3	34	256	...	...	...	...	...	...	3	39	281	...				...
Sheep, bucks	3	3	23	...	...	...	...		...	3	9	47	...	.			...
Lambs, weaned	1	12	24	...	...	...	2	31	262	1	7	35	...	.			...
Brood sows	29	51	1,400	...	...	...	10	11 7	295	31	49	1,304	5	6	11	16 3	$ 508
Other hogs	12	39	604	4	7	96	23	98	1,863	9	28	360	2	7	50	122	2,967
Pigs, weaned	7	21	116	21	77	279	14	138	615	4	37	99	2	2	1	24	12
Chickens	66	3,740	3,915	4	1,095	509	23	1,665	1,205	67	4,377	4,551	...		...	.	...
Turkeys	13	55	320	6	19	97	12	306	1,402	17	75	370	...		.	...	...
Ducks	4	12	16	1	5	5	5	18	24	6	18	27	...	.	.	...	...
Guinea hens	2	16	16	...	.	...	1	14	14	2	10	10	...	.	...	...	...
Bees*	2	22	132		...	...	...			2	22	132		.		.	.
Total	...	.	$43,062		.	$2,676	...	...	$6,795	...		$42,726				.	$3,487

*Two farms had 22 colonies of bees at the beginning and at the end of the year.

MILK SOLD

The milk in the La Fargeville area is sold chiefly to cheese factories. The number of farmers selling to each factory each month of the year studied is shown in table 15:

TABLE 15. NUMBER OF FARMERS DELIVERING MILK TO EACH FACTORY EACH MONTH

Operator or factory, and location	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
Adam Bickelhaupt Cheese Factory, Theresa	2	2	2	2	2	2	...	....	...	....	..	2
Adam Bickelhaupt's factories nos. 15 and 25, near La Fargeville	5	5	5	5	5	5	1	1	...	...	3	4
Amity Dairy Co., Plessis	1	1	1	1	1	1	1	1	1	1	1	1
B. B. Miller and Sons, Orleans Four Corners	...	...	...	...	...	...	2	1	1	....	1	1
Benjamin Marks, Plessis	1	1	1	1	1	1	1	3	3	3	3	....
Borden's Farm Products Co., La Fargeville	1	2	3	3	3	3	3	2	2	3	3	2
Cold Brook Cheese Factory, Tanners Corners	8	8	7	7	7	7	6	6	....	...	...	6
E. W. Coon, Tanners Corners	4	4	5	5	5	5	5	5	...	....	1	4
E. W. Coon, Omar	2	2	2	2	2	2	2	2	..	....	2	3
E. W. Coon, Chaumont	2	2	2	2	2	2	2	2	2	2	2	2
Flat Rock Cheese Factory, Plessis	...	...	....	....	....	....	....	....	..	....	....	1
Hill Spring Cheese Factory, Omar	5	5	5	5	5	5	5	4	...	....	5	4
Hygienic Dairy Co., Watertown	...	....	...	....	....	....	5	5	4	1	1	....
Jacob Vogt, Carter St., near La Fargeville (Limburger)	1	1	1	1	1	1	2	....	....	....	...	...
John S. Martin and Co., Depauville	9	9	9	9	9	9	9	9	3	4	6	7
J. S. Martin, Pillar Point	1	1	1	1	1	1	1	1	1	1	....	1
B. B. Miller and Sons, Depauville	1	1	1	1	1	1	2	2	1	1	1	1
Orleans Center Cheese Factory, Orleans Center	7	7	6	6	6	6	4	....	....	....	3	8
Orleans Four Corners Dairymen's League Cooperative Association, Orleans Four Corners	7	7	7	5	....	1	8	7	7	8	8	7
Orleans Valley Cheese Factory, Barlows Corners	2	2	2	8	8	7	....	....	...	....	....	1
Perch Lake Cheese Factory, Perch Lake	....	....	...	1	1	1	....	...	....	....	....	....
Perch River Cheese Factory, Perch River	3	3	3	3	3	3	3	....	....	....	1	2
Spring Brook Cheese Factory, Omar	....	....	....	....	....	....	....	....	...	...	1	1
Stone Mills Union Factory, near La Fargeville	3	2	2	2	2	2	1	....	....	...	....	1
Tallman Cheese Factory (Vogt), La Fargeville	3	3	3	3	3	3	3	1	1	....	2	3

The majority of the farmers did not sell their milk thru the Dairymen's League Cooperative Association, Inc., but delivered and sold it directly to the cheese factories. The amount of milk sold each month, and the receipts for milk, are shown in table 16.

The average price received for pooled milk by the La Fargeville farmers was \$1.91 per 100 pounds, of which \$1.75 was cash and 16 cents was in certificates of indebtedness. The average price for milk sold directly to the factories was \$1.52 per 100 pounds.

The amount of milk required in the making of one pound of cheese at the Orleans Valley Cheese Factory, and the price received by the patrons of this factory per 100 pounds of milk delivered, are shown in table 17.

TABLE 16. RETURNS FROM MILK SOLD, 67 FARMS

Month	Milk pooled*						Milk not pooled			
	Number of farms selling milk	Number of pounds of milk sold	Amount received by farmers for milk				Number of farms selling milk	Number of pounds of milk sold	Amount received by farmers for milk	
			Certificates of indebtedness	Cash	Total	Total per 100 pounds			Total	Total per 100 pounds
1921:										
May (pasture)	.....	16,785	$ 17	$ 258	$ 275	....	......	439,570	$4,831	....
May (winter)	.....	19,624	20	304	324	....	......	362,029	3,922	....
June (pasture)	.....	39,986	40	402	442	....	......	842,188	9,585	....
June (winter)	.....	....	....	....	....	....	......	7,655	81	....
May (total)	2	36,409	37	562	599	$1.65	65	801,599	8,753	$1.09
June (total)	2	39,986	40	402	442	1.10	65	849,843	9,666	1.14
July	20	181,510	181	2,642	2,823	1.56	48	501,200	7,338	1.46
August	20	176,959	350	3,342	3,692	2.09	48	481,023	8,261	1.72
September	21	165,648	331	3,379	3,710	2.24	47	406,407	7,464	1.84
October (pasture)	......	58,821	118	1,444	1,562	....	......	215,566	4,535	....
October (winter)	.....	60,244	121	1,453	1,574	....	......	79,909	1,766	....
November (pasture)	.....	1,307	3	32	35	....	......	3,532	69	....
November (winter)	.....	87,413	175	2,014	2,189	....	......	127,187	3,031	....
October (total)	21	119,065	239	2,897	3,136	2.63	47	295,475	6,301	2.13
November (total)	28	88,720	178	2,046	2,224	2.51	36	130,719	3,100	2.37
December	28	64,945	130	1,498	1,628	2.51	24	64,002	1,755	2.74
1922:										
January	17	51,685	104	1,003	1,107	2.14	11	47,579	1,213	2.55
February	17	64,592	129	1,199	1,328	2.06	9	47,153	1,195	2.53
March	18	132,360	265	1,906	2,171	1.64	25	126,882	2,315	1.82
April	25	227,434	236	2,679	2,915	1.28	36	243,640	3,397	1.39
Total:										
Pasture	.....	641,016	$1,040	$11,499	$12,539	$1.96	......	2,889,486	$42,083	$1.46
Winter	.....	708,297	$1,180	$12,056	$13,236	$1.87	......	1,106,036	$18,675	$1.69
Year	......	1,349,313	$2,220	$23,555	$25,775	$1.91	......	3,995,522	$60,758	$1.52

* Milk pooled was that sold thru the Dairymen's League Cooperative Association, Inc. This milk entered into the league pool, and the producer received the net pool price paid by the association. The amount that the dealer paid represents the money which the local buying companies paid to the cooperative association for milk delivered by members of the association, or paid directly to farmers not affiliated with the cooperative association.

TABLE 17. MILK REQUIRED IN THE MANUFACTURE OF CHEESE, AND PRICES PAID TO PATRONS, ORLEANS VALLEY CHEESE FACTORY

Milk delivered from	Pounds of milk required for one pound of cheese	Price received by patrons per 100 pounds of milk
March 24 to April 10	12.0	$1.414
April 11 to 27	11.7	1.070
April 28 to May 11	11.6	0.972
May 12 to 28	10.7	1.026
May 26 to June 8	11.08	1.026
June 9 to 23	11.3	1.037
June 24 to July 7	12.16	1.073
July 8 to 21	....	1.318
July 22 to August 4	11.8	1.462
August 5 to 18	11.04	1.493
August 19 to September 1	10.73	1.538
September 2 to 15	10.72	1.620
September 16 to 30	10.12	1.790
October 1 to 14	10.48	1.809
October 15 to 31	9 0	2.155

The price paid by the Dairymen's League Cooperative Association, Inc., to one patron delivering milk to a plant in this area, is shown in table 18:

TABLE 18. POOL PRICES PAID TO ONE PATRON AT DEPAUVILLE BY THE DAIRYMEN'S LEAGUE COOPERATIVE ASSOCIATION, INC.

	Per 100 pounds of milk		
	Grade deductions* (cents)	Certificates of indebtedness (cents)	Total price paid to farmers
1921:			
May	....	10	$1.38
June	....	10	1.05
July	....	10	1.48
August	....	20	1.68
September	....	20	1.78
October	....	20	2.17
November	26.1	20	1.74
December	12.5	20	2.00
1922:			
January	15.0	20	1.65
February	15.0	20	1.50
March	2.5	20	1.25
April	4.0	10	1.08

* Grade deductions, as indicated in the table, were made from November to April because the milk was used for making cheese.

The monthly distribution of milk production on the farms in the La Fargeville area is given in table 19:

TABLE 19. DISTRIBUTION OF MILK PRODUCTION, 67 FARMS

	Total pounds of milk sold	Per cent	Value received by farmers, including certificates of indebtedness	
			Total	Per farm
1921:				
May	838,008	15.7	$ 9,352	$140
June	889,829	16.6	10,108	151
July	682,710	12 8	10,161	152
August	657,982	12 3	11,953	178
September	572,055	10.7	11,174	167
October	414,540	7.8	9,437	141
November	219,439	4.1	5,324	79
December	128,947	2 4	3,383	50
1922:				
January	99,264	1 9	2,320	35
February	111,745	2.1	2,523	38
March	259,242	4 8	4,486	67
April	471,074	8.8	6,312	94
Total	5,344,835	100 0	$86,533	$1,292
Total pasture	3,530,502	66 1	$54,622	$815
Total winter	1,814,333	33 9	$31,911	$477

MISCELLANEOUS RECEIPTS

The miscellaneous receipts from the farms studied are given in table 20:

TABLE 20. MISCELLANEOUS RECEIPTS, 67 FARMS

	Amount	Price	Value		
			Farm	Operator	Landlord
Human labor off farm	404 3 days.	$3.15	$1,274	$1,274	......
Horse labor off farm	226.8 days	1.97	446	446	....
Use of machinery	154 days	5.35	824	824	....
Rent of pasture	....	......	125	125	....
Maple sirup	85 gallons	1.94	165	160	$ 5
Maple sugar	600 pounds	0.25	150	150	....
Honey	250 pounds	0.32	63	63	....
Wood	982 cords	3.54	3,480	1,900	1,580
Wool	200 pounds	0.28	55	35	20
Eggs	15,864 dozen	0.42	6,672	6,651	21
Chicks	6,781	0.11	746	746	....
Feed bags	300	0.05	15	15	....
Breeding fees	....	......	72	72	....
Hides	56	1.46	82	61	21
Insurance	....	......	1,000	....	1,000
Total	....	......	$15,169	$12,522	$2,647
Per farm	....	......	$227	$187	$40

FARM EXPENSES

The current operating expenses per farm were \$1513, of which 40.2 per cent was for labor, 9.8 per cent was for cattle and horse feed, 10.8 per cent was for taxes, and 39.2 per cent was for all other items (table 21). The expense for new buildings averaged \$91 per farm, and the purchase of livestock averaged \$77 per farm. The total expenses thus amounted to \$1681 per farm.

TABLE 21. EXPENSES ON 67 FARMS

	Value		
	Total	Per farm	Per cent
Labor, hired	\$ 8,636	\$129	8.5
Labor, unpaid	28,359	423	28.0
Board of hired labor	3,721	56	3.7
Advertising	5	....	....
Baling	5	....	....
Egg cases	109	2	0.1
Bedding	22	....	....
Breeding fees	295	4	0.3
Building repairs	4,373	65	4.3
Pasturage	617	9	0.6
Commissions	100	2	0.1
Express	132	2	0.1
Salt	756	11	0.7
Hay, silage, straw, and stalks	1,754	26	1.7
Hog, poultry, and chick feed	4,300	64	4.2
Cattle and horse feed	9,977	149	9.8
Grinding feed	1,090	16	1.1
Fence, wire, posts, etc	1,260	19	1.3
Fertilizer	257	4	0.3
Lime	2	....	....
Horseshoeing	2,120	32	2.1
Insurance	1,014	15	1.0
Sawing lumber	200	3	0.2
Machinery, new	3,514	53	3.5
Machinery, repairs	2,448	37	2.4
Machinery, hired	404	6	0.4
Filling silo	754	11	0.7
Threshing	1,570	24	1.6
Coal, oil, gasoline, for farm use	2,902	43	2.9
Twine	850	13	0.8
Farm share of upkeep and operation of automobile	2,284	34	2.3
Ice	76	1	0.1
Hauling milk	462	7	0.5
Milk bottles, cans, strainers	494	7	0.5
Registration fees	14	....	....
Grass seed	2,800	42	2.8
Other seeds and plants	625	9	0.6
Spray materials	215	3	0.2
Stamps, stationery, for farm use	41	1	....
Telephone, farm use	406	6	0.4
Taxes (including school tax)	10,915	163	10.8
Veterinary, medicine	527	8	0.5
Carbide	21	....	....
Hatching eggs	10	....	....
Chicks	30	....	....
Any other farm expenses	874	13	0.9
Total (except cash rent and new buildings)	\$101,340	\$1,513	100.0

TABLE 21 (*concluded*)

	Value		
	Total	Per farm	Per cent
Cash rent	$3,185		
New buildings:	6,130	$91	
Operator	(1,730)	....	....
Landlord	(4,400)	....	....
Total	$110,655	....	....
Livestock purchased:	5,169	$77	....
Operator	(4,036)	....	....
Landlord	(1,133)	....	....
Total (except cash rent)	$112,639	$1,681	....

LABOR INCOMES

The labor income is the amount which a farmer receives as pay for his year's work, in addition to the use of a house and to the products furnished by the farm toward his living, such as food and fuel.

The difference between the total farm receipts of $2002 per farm, and the farm expense of $1681 per farm, was $321. Interest at 5 per cent on the $13,909 capital was $695, which when deducted from $321, the farm income, leaves an average labor income of minus $374; in other words, the difference between the farm receipts and the farm expenses lacks $374 of equaling the interest on the investment, without allowing the farmer any cash reward for his time. The method of computing labor income is shown in table 22:

TABLE 22. LABOR INCOMES ON 67 FARMS

Average capital (table 7) $13,909	
Receipts (table 9)	$2,002
Expenses (table 21)	1,681
Farm income (difference)	$321
Interest at 5 per cent	$695
Labor income	−$374

The average cash living costs for the operators' families were $296 for food, $157 for clothes, and $160 for other expenses; a total of $613 per farm, or $51 per month.

The variation in labor income on these farms is shown in table 23:

TABLE 23. VARIATION IN LABOR INCOME ON 67 FARMS

	Farms making labor incomes as designated				
	Minus $500 or more	Minus $499 to 0	Plus $1 to $500	Plus $501 to $1000	More than $1000
Number of farms	28	19	14	3	3

TABLE 24. [illegible]

Kind of feed	Total			Cows			
				Pasture period		Winter period	
	Amount (cwt.)	Average price per ton	Value	Amount (cwt.)	Value	Amount (cwt.)	Value
Home-grown:							
Corn for grain	12	$31.67	$ 19	9	$14	3	$ 5
Corn for grain, surplus silage	564	70 85	1,998	......	.....	325	1,154
Oats	7,237	32.73	11,843	5	10	3,852	6,121
Oats, 1920	560	38.29	1,072	17	40	398	734
Oats and barley	2,510	31 98	4,014	5	8	1,290	2,088
Oats and barley, 1920	484	35 04	848	......	......	455	790
Oats, barley, and peas	493	32.01	789	......	......	425	680
Oats, barley, and buckwheat	250	34.96	437	......	......	20	35
Oats, wheat, and buckwheat, 1920	68	35.00	119	......	......	68	119
Oats, speltz, and wheat	301	35.02	527	......	......	104	182
Barley	44	46.36	102	......	......	34	78
Barley, 1920	12	40.00	24	......	......	12	24
Spring wheat	14	47.14	33	......	......	8	19
Total home-grown	12,549	$34.78	$21,825	36	$72	6,994	$12,029
Purchased:							
Cornmeal	415	$ 34.75	$ 721	9	$ 10	371	$ 646
Hominy	42	37.14	78	......	......	42	78
Ground corn and oats	166	36.27	301	......	......	138	251
Cracked corn	35	36.57	64	......	......	......	......
Whole corn	12	36.67	22	......	......	......	......
Whole oats	240	35.83	430	......	......	146	240
Ground oats	158	34.18	270	20	38	111	186
Wheat bran	489	29.37	718	69	88	359	545
Wheat feed	82	30.98	127	......	......	82	127
Wheat middlings	251	30.76	386	69	88	167	274
Gluten feed	88	40.91	180	4	11	79	159
Cottonseed meal	267	53.11	709	15	31	245	657
Oilmeal	146	55.75	407	1	3	134	373
Beet pulp	25	52.80	66	17	45	8	21
Bull Brand Dairy Ration	870	49.75	2,164	......	......	823	2,058
Schumacher Feed	553	41.48	1,147	140	266	295	611
Stevens 44	273	50.55	690	133	366	140	324
Blue Bell Dairy Ration	120	36.67	220	......	......	120	220
Pillsbury Dairy Ration	60	45.00	135	......	......	60	135
Badger	60	41.67	125	......	......	60	125
Farmer Jones	40	55.00	110	......	......	40	110
Tested	40	52.00	104	......	......	40	104
Keynote	40	33.00	66	......	......	40	66
Beacon	30	53.33	80	......	......	30	80
[illegible]	20	63.00	63	......	......	20	63
Hylo	20	47.00	47	......	......	20	47
Cornell Ration	15	40.00	30	......	......	15	30
Pillsbury's Stock Feed	10	40.00	20	......	......	......	......
Other dairy rations	120	48.00	288	......	......	120	288
Molasses	23	40.87	47	......	......	23	47
Blatchford's Calf Meal	8	105.00	42	......	......	......	......
Security Calf Meal	1	320.00	16	......	......	......	......
Other calf meals	29	71.72	104	......	......	......	......
Total purchased	4,748	$42.03	$9,977	477	$946	3,728	$7,865
Total concentrates	17,297	$36.77	$31,802	513	$1,018	10,722	$19,894

Heifers		Herd bulls		Horses	
Amount (cwt.)	Value	Amount (cwt.)	Value	Amount (cwt.)	Value
......	......	......	......	......	.
204	$724	30	$110	5	$ 10
194	300	94	181	3,092	5,231
29	76	2	5	114	217
115	181	15	23	1,085	1,714
25	50	4	8	...	...
......	......	......	......	68	109
......	......	......	......	230	402
......	......	......	......	......	......
25	44	......	......	172	301
2	5	......	......	8	19
......	......	......	......	......	......
......	.	......	......	6	14
594	$1,380	145	$327	4,780	$8,017
26	$ 49	9	$16	......	......
......	......	......	......	......	......
8	14	......	......	20	$ 36
......	......	......	......	35	64
......	......	......	......	12	22
5	9	......	......	89	181
16	26	1	2	10	18
23	33	1	2	37	50
......	......	......	......	......	......
12	19	......	......	3	5
5	10	......	......	......	......
7	21	......	......	......	......
10	28	......	......	1	3
......	......	......	......	......	......
37	84	10	22	......	......
28	74	......	......	90	196
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	......	......
......	......	......	......	10	20
......	......	......	......	......	......
......	......	......	......	......	......
8	42	......	......	......	......
1	16	......	......	......	......
29	104	......	......	......	......
215	$529	21	$42	307	$595
809	$1,909	166	$369	5,087	$8,612

COSTS AND RETURNS IN PRODUCING MILK

The costs in producing milk are considered under the following headings: concentrates, succulent feed, dry forage, pasture, bedding, labor, hauling milk, use of buildings, use of equipment, interest, depreciation on cows, bull service, and miscellaneous charges. The returns are considered under the following headings: milk and milk products, calves born during the year, and manure.

COSTS

Concentrates

The average value of home-grown grain was $34.78 per ton, and of purchased concentrates $42.03 per ton, the average of all being $36.77 per ton. The kinds, amounts, and costs of concentrates used are indicated in table 24. The cost of concentrates per 100 pounds of milk produced was 34 cents; and the cost per cow was $17.

Succulent feed

The average value of corn silage per ton was $6.76 (table 25). An average of 41 tons was used per farm. Very little succulent feed was used supplementary to pasture, less than in the other areas previously reported where dairying is more intensively followed.

The soil of this area is not particularly well adapted for the production of corn for the silo. It is heavy and does not dry out quickly in the spring, and unless it is cultivated under just the proper moisture conditions, it tends to be compact. Corn requires a loose, friable, warm soil, for best growth. This fact, together with the fact that the production of milk for cheese factories necessitates the production of most of it during the pasture period, makes the use of a silo of more questionable economic advantage in this area than in any of the other areas studied. As time goes on, regions now producing milk for the cheese-factory will probably be absorbed in the area producing milk for the metropolitan district, the same as they have been in the past. When this takes place, a silo will be of more decided advantage in this system of dairy farming.

The charge for succulent feed averaged $13.12 per cow, or 27 cents per 100 pounds of milk produced.

Dry forage

The average value of all hay per ton was $15.77 (table 26). The average value of all dry forage, home-grown and purchased, was $14.08. A large amount of oat straw was used, and about equal amounts of timothy and of clover and hay containing a mixture of clover.

The charge for dry forage averaged $27.34 per cow, or 55 cents per 100 pounds of milk produced.

Quantities of feed used

The amounts of feed used per cow and per unit of product are given in tables 27 and 28. The amount of concentrates used in the cheese-factory area is about half of that used in the market-milk areas. Of the concen-

TABLE 25. SUCCULENT FEED USED BY 1230 COWS, 406 HEIFERS, 77 HERD BULLS, AND 265 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Corn silage	2,732	$6.76	$18,474	46	$310	2,238.5	$15,131	365.8	$2,476	78.3	$534	3.4	$23
Corn silage, 1920	36	6.76	243	26	175	10	68	......	......	......	......	......	......
Corn, green	52	4.90	255	52	255	......	......	......	......	......	......	......	......
Sweet corn	8	6.25	50	8	50	......	......	......	......	......	......	......	......
Oats	6	4.33	26	6	26	......	......	......	......	......	......	......	......
Oats, peas, and barley	10	5.00	50	10	50	......	......	......	......	......	......	......	......
Buckwheat	2	8.00	16	2	16	......	......	......	......	......	......	......	......
Alfalfa, second cutting	8	7.00	56	8	56	......	......	......	......	......	......	......	......
Total home-grown	2,854	$6.72	$19,170	158	$938	2,248.5	$15,199	365.8	$2,476	78.3	$534	3.4	$23
Purchased:													
Corn silage	1	$2.00	$2	......	......	1	$2	......	......	......	......	......	......
Total purchased	1	$2.00	$2	......	......	1	$2	......	......	......	......	......	......
Total succulent feed	2,855	$6.72	$19,172	158	$938	2,249.5	$15,201	365.8	$2,476	78.3	$534	3.4	$23

TABLE 26. DRY FORAGE USED BY 1230 COWS, 406 HEIFERS, 77 HERD BULLS AND 265 HORSES

Kind of feed	Total			Cows				Heifers		Herd bulls		Horses	
				Pasture period		Winter period							
	Amount (tons)	Average price per ton	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:													
Alfalfa, first cutting	16	$16.31	$ 261			16	$ 261						
Alfalfa, second cutting	2	20.00	40			2	40						
Mixed hay (clover)	695.5	15.07	10,478	12	$220	495.3	7,378	117.3	$1,835	29.9	$462	41	$ 583
Mixed hay (other)	796	16.62	13,230	2	30	485.1	8,160	54.1	932	22.8	387	232	3,721
Sweet clover	8	8.00	64			8	64						
Timothy	1,305	15.78	20,598	2	38	705	11,046	186	2,926	57	888	355	5,700
Oat hay	6	18.00	108			6	108						
Buckwheat hay	1.5	20.00	30			1.5	30						
Swale hay	29	6.76	196			26	175	3	21				
Mixed hay (other), 1920	94	16.53	1,554			49	812			2	40	43	702
Timothy, 1920	13	17.23	224			13	224						
Total hay	2,966	$15.77	$46,783	16	$288	1,806.9	$28,298	360.4	$5,714	111.7	$1,777	671	$10,706
Oat straw	404.7	$ 7.61	$3,081			298.7	$2,285	31.5	$228	9.5	$81	65	$487
Oat and barley straw	73	6.30	460			55	361	5	29			13	70
Oat, barley, and wheat straw	6	10.00	60			2.5	25	0.3	3	0.2	2	3	30
Oat, barley, and pea straw	10	5.00	50			7	35	2	10			1	5
Oat, barley, and buckwheat straw	6	10.00	60			3	30					3	30
Wheat straw	1	10.00	10			1	10						
Corn fodder	97	4.41	428	3	$27	82.1	349	9.3	43	2.6	9		
Corn stover	61	6.00	366	18	76	42.5	288	0.5	2				
Corn for the silo (surplus fodder)	17	4.88	83			15	73	2	10				
Total straw, stover, etc.	675.7	$6.80	$4,598	21	$103	506.8	$3,456	50.6	$325	12.3	$92	85	$622
Total home-grown	3,641.7	$14.11	$51,381	37	$391	2,313.7	$31,754	411	$6,039	124	$1,869	756	$11,328
Purchased:													
Mixed hay (clover)	5	$15.00	$ 75			5	$ 75						
Mixed hay (other)	84.1	14.07	1,183			72	990	2.8	$34	0.3	$3	9	$156
Timothy and clover	26	15.58	405			22.5	351	1	15			2.5	39
Timothy	5	10.00	50	4	$40			0.5	5			0.5	5
Oat straw	6.5	4.62	30			5	12					1.5	18
Wheat straw	4	2.00	8			2.5	5					1.5	3
Corn fodder	1	1.00	1			1	1						
Total purchased	131.6	$13.31	$1,752	4	$40	108	$1,434	4.3	$54	0.3	$3	15	$221
Total dry forage	3,773.3	$14.08	$53,133	41	$431	2,421.7	$33,188	415.3	$6,093	124.3	$1,872	771	$11,549

trates fed to cows, 63 per cent was home-grown; this consisted chiefly of oats, and oats and barley. Large quantities of roughage per unit of product are necessary because the cows are dry in winter.

TABLE 27. AMOUNTS OF FEED USED PER COW AND PER UNIT OF PRODUCT, FOR THE YEAR, IN POUNDS

	Per cow	Per 100 pounds of milk produced
Concentrates	913	18.4
Silage	3,775	75.9
Other succulent feed	140	2.8
Dry forage	4,004	80 6
Days of pasture	161	3.2
Acres of pasture	3.9	....

TABLE 28. AMOUNTS OF FEED USED PER COW PER DAY AND PER UNIT OF PRODUCT, IN POUNDS

	Per cow per day in winter	Per 100 pounds of milk produced in winter period	Per 100 pounds of milk produced in pasture period
Concentrates	4.3	42 5	1.4
Silage	17.9	178.5	4.0
Other succulent feed	....	....	4.8
Dry forage	19 3	192.1	2.3
Days of pasture	....	....	5.5
Acres of pasture	....	....	0.13

Pasture

The average date of turning the cows out to pasture was May 15, and that of stabling in the fall was October 22, making a pasture season of 161 days.

The average equivalent in acres to open pasture of the land pastured, excluding the meadows, was 2.9 per animal unit pastured.

The charge for pasture was $8.17 per cow, in addition to a charge of $1.94 per animal unit for afterfeed on the meadows (table 29); making a total pasture charge of $10.11 per cow, or 20 cents per 100 pounds of milk produced. In this region the dairy is allowed to roam over the meadows for a longer period than in other sections.

On the La Fargeville farms there were 4761 acres of pasture land, valued at $108,415. The receipts for milk sold during the pasture season amounted to $54,622. The value of feed used by cows supplementary to pasture was $2387. The returns from the pasture, labor, and investment in cattle were $52,235, which is $780 per farm, or $10.97 per acre of pasture.

TABLE 29. PASTURE CHARGES ON 67 FARMS

	Number of animal units pastured	Charge for pasture	
		Total	Per animal unit
Cows	1,225	$10,048	$8.20
Heifers	190	1,583	8.33
Bulls	71	511	7.20
Horses	143.5	721	5.02
Meadows pastured after hay was removed	997	$2,382	$2.39

Bedding

An average of 6.6 tons of bedding was used per farm. The charge for bedding was $1.35 per cow, or 3 cents per 100 pounds of milk produced. The kinds, the amounts, and the value of the bedding used on these farms are given in table 30:

TABLE 30. BEDDING USED ON 67 FARMS

Kind of bedding	Cows		Heifers		Herd bulls		Horses	
	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value	Amount (tons)	Value
Home-grown:								
Oat straw	140.5	$930	30.5	$223	7.8	$57	78.5	$565
Oat straw, 1920	20	121	2	14	......	......	......	......
Oat and barley straw	41	282	2	16	1	5	22	152
Oat, barley, and wheat straw	1.7	17	0.2	2	0.1	1	2	20
Oat, barley, and buckwheat straw	2	20	......	......	......	......	2	20
Oat, barley, and pea straw	15.3	104	4	26	0.7	6	4	26
Oat, speltz, and wheat straw	5	30	1.5	9	0.5	3	4	24
Barley straw	11.5	70	2.5	16	1	6	5	26
Barley and wheat straw	1.5	15	......	......	0.5	5	......	......
Wheat straw	11	59	......	......	......	......	7	40
Spring wheat straw	......	......	......	......	......	......	3	15
Total	249.5	$1,648	42.7	$306	11.6	$83	127.5	$888
Purchased:								
Oat straw	5	$12	......	......	......	......	......	......
Wheat straw	3	5	......	......	......	......	1	$2
Shavings	......	......	......	......	......	......	3	1
Sawdust	1	1	......	......	......	......	1	1
Total	9	$18	......	......	......	......	5	$4
Total bedding	258.5	$1,666	42.7	$306	11.6	$83	132.5	$892

Labor

The average rate per hour for operator's labor was 28 cents; for hired man's labor, 16 cents; and for all human labor, 23 cents. The rate for horse labor was 15 cents per hour. The variations in the rates asked by operators, and in the estimated rates paid for hired labor, are given in table 31.

TABLE 31. VARIATIONS IN RATES PER HOUR FOR OPERATORS AND FOR HIRED MEN

Rate per hour (cents)	Operators		Hired men	
	Number of farms	Per cent	Number of farms	Per cent
4	....	....	1	5.5
10	....	....	2	11.1
12	1	1.5	....	....
13	....	....	2	11.1
14	....	....	1	5.5
15	2	3.0	2	11.1
16	....	....	1	5.5
17	....	....	2	11.1
18	3	4.6	1	5.6
20	4	6.1	3	16.7
21	1	1.5	1	5.6
22	2	3.0	1	5.6
25	12	18.2	....	....
26	7	10.6	....	....
27	3	4.6	1	5.6
29	2	3.0	....	....
30	11	16.7	....	....
32	3	4.5	....	....
33	6	9.1	....	....
35	5	7.6	....	....
40	3	4.5	....	....
80	1	1.5	....	....
Total	66*	100.0	18	100.0

* One operator did no work on cows.

For the year, the average time spent per cow amounts to 146 hours, or 2.9 hours per 100 pounds of milk produced (table 32). The average rate received for man labor above all other costs in the production of milk was minus 1.7 cents per hour; that is, the returns lacked 1.7 cents an hour of paying the costs other than labor.

The charge for labor averaged $30.37 per cow, or 61 cents per 100 pounds of milk produced.

TABLE 32. LABOR REQUIRED IN PASTURE AND WINTER PERIODS

	Hours in pasture period				Hours in winter period				Total hours			
	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value	Total	Per cow	Per 100 pounds of milk	Total value
Human labor for cows:												
Hauling milk	9,252	7.5	0.2	$ 2,248	8,201	6.7	0.3	$ 1,993	17,453	14.2	0.2	$ 4,241
Milking	45,138	36.7	1.3	10,402	37,533	30.5	1.5	8,650	82,671	67.2	1.4	19,052
Other human labor	11,876	9.7	0.3	2,727	67,676	55.0	2.7	15,577	79,552	64.7	1.3	18,304
Total	66,266	53.9	1.8	$15,377	113,410	92.2	4.5	$26,220	179,676	146.1	2.9	$41,597
Total except hauling milk	57,014	46.4	1.6	$13,129	105,209	85.5	4.2	$24,227	162,223	131.9	2.7	$37,356
Horse labor for cows:												
Hauling milk	11,117	9.0	0.3	$1,644	11,989	9.8	0.5	$1,773	23,106	18.8	0.4	$3,417
Other horse labor	....	......	......	....	8,923	7.2	0.3	1,343	8,923	7.2	0.1	1,343
Total	11,117	9.0	0.3	$1,644	20,912	17.0	0.8	$3,116	32,029	26.0	0.5	$4,760
Human labor for heifers	897	......	......	$211	12,547	......	......	$2,937	13,444	......	......	$3,148
Horse labor for heifers	....	......	......	......	1,297	......	......	$200	1,297	......	......	$200

Hauling milk

The average distance from the farms to the milk stations in the La Fargeville area was 1.4 miles. The charges for hauling milk are given in table 33. They amounted to 14 cents per 100 pounds of milk produced, or 16 cents per 100 pounds of milk sold, or $7.02 per cow.

TABLE 33. CHARGES FOR HAULING AND DELIVERING MILK TO FACTORIES, 53,448 HUNDREDWEIGHT OF MILK

	Pasture period	Winter period	Total
Human labor:			
Number of farms	67	65	67
Hours	9,252	8,201	17,453
Value	$2,248	$1,993	$4,241
Horse labor:			
Number of farms	62	64	65
Hours	11,117	11,989	23,106
Value	$1,644	$1,773	$3,417
Value of total human and horse labor	$3,892	$3,766	$7,658
Hauling hired:			
Number of farms	....	....	12
Cash paid	....	....	$462
Use of automobiles and trucks:			
Number of farms	....	....	6
Value	....	....	$512
Total charges for hauling milk	....	....	$8,632
Amount received for hauling milk	....	....	....
Total net cost of hauling milk	....	....	$8,632
Cost per 100 pounds of milk sold	....	....	$0.16

Use of buildings

The average charge for the use of buildings was $6.78 per cow, or 14 cents per 100 pounds of milk produced. The data are given in table 34:

TABLE 34. CHARGES FOR USE OF BUILDINGS

Value of barns and other buildings used for dairy cattle	$121,995
Interest at 5 per cent	$6,098
Taxes	1,846
Insurance	391
Repairs	1,736
Total	$10,071
Charged to:	
Cows	$8,345
Heifers	1,271
Herd bulls	455
Total	$10,071

Of the 67 La Fargeville farmers, 20 had their barns arranged so that the cows faced outward, and 17 drove thru for the manure. There were 58 barns that had straight stanchions, and 9 that had swing stanchions. Of the floors, 46 were concrete and 21 were wood. Only 8 farmers had water buckets in the barn, 46 watered the cows in the yards, 3 used barn troughs, and the remainder watered the cows in the adjacent springs or creeks.

Use of equipment

The charge for the use of equipment was $1.43 per cow, or 3 cents per 100 pounds of milk produced.

The year of purchase, and the number and kinds of milking machines on these farms, were: 1914, one Hinman; 1915, one Visible; 1916, one Hinman, one Visible, one Sharples; 1917, one Hinman, one Universal, two Visible, one Sharples; 1918, three Hinman, two Visible; 1919, four Hinman, one Visible, one Pine Tree; 1920, one Universal, two Pine Tree, one Empire; 1921, one Hinman, one Sharples. Of these machines, 23 were used and 4 were not used during the year studied. The 23 were used as follows: 3 in January, 3 in February, 6 in March, 11 in April, 22 in May, 23 in June, 23 in July, 22 in August, 17 in September, 11 in October, 5 in November, 3 in December; making a total of 149 months out of 276, or 54 per cent of the time.

On the 67 farms, there were two Ford trucks, one Republic truck, and one Vim truck. Nine farms had tractors of the following makes: Avery, one; Case, two; Fordson, three; International, one; Samson, one; Titan, one.

Interest

The charge for interest on cows amounted to $3.62 per cow, or 7 cents per 100 pounds of milk produced.

Depreciation on cows

The average value of grade cows was $59.47; of purebreds, $87.17; of both, $60.41. The depreciation was $2.99 per cow, or 6 cents per 100 pounds of milk produced. The average decrease in market value of grade cows during the year was $14.97, and that for purebreds was $24. This was not included as a charge.

The proportion of cows that were sold, that were eaten on the farms, and that died, was 15.1 per cent. Of the cows added to the herd, 15.3 per cent were purchased and 84.7 per cent were raised.

Bull service

The average cost of keeping 77 herd bulls was $64.76 per cattle unit, $3.59 per cow kept, or 7 cents per 100 pounds of milk produced. The appreciation on bulls averaged $9.91 per cattle unit. The data are given in table 35:

TABLE 35. COST OF BULL SERVICE ON 67 FARMS

	Total		Per cattle unit	
	Amount	Value	Amount	Value
Costs:				
Concentrates	166 cwt.	$ 369	244 lbs.	$ 5.42
Succulent feed	78.3 tons	534	2,300 lbs.	7.84
Dry forage	124.3 tons	1,872	3,651 lbs.	27.49
Bedding	11.6 tons	83	341 lbs.	1.22
Whole milk	10,670 lbs.	135	157 lbs.	1 98
Whey	1,700 lbs.	2	25 lbs.	0.03
Skimmilk	753 lbs.	2	11 lbs.	0.03
Pasture	....	511	....	7.50
Interest	....	206	....	3.03
Use of buildings	....	455	....	6 68
All other costs	....	1,506	....	22.11
Total	....	$5,675	....	$83.33
Returns:				
Appreciation	....	$675	....	$9.91
Manure	427 tons	590	6 3 tons	8.66
Total	....	$1,265	....	$18.57
Cost of keeping own herd bull	....	$4,410	....	$64.76
Net cost per cow	....	$3.59	....	.....
Number of herd bulls	....	77	....	.....
Cattle units of herd bulls	....	68.1	....	.....

Miscellaneous charges

The remaining expenses of producing milk are chiefly expense for grinding feed, for salt, and for gasoline and oil to run the milking machines (table 36). The miscellaneous expenses amounted to $2.26 per cow, or 5 cents per 100 pounds of milk produced.

TABLE 36. MISCELLANEOUS EXPENSES FOR COWS

Item	Charge
Salt	$567
Grinding feed	700
Insurance	224
Coal, oil, gasoline	522
Farm share of upkeep and operation of automobile	99
Ice	68
Spray materials	213
Telephone	55
Stamps and stationery	5
Veterinary, medicines	331
Total	$2,784
Total per cow	$2.26
Total per 100 pounds of milk produced	$0.05

RETURNS

Milk and milk products

The amounts of and the returns for milk sold to the factories have been given in tables 16 and 19 (pages 17 and 19). The average receipts for milk sold were $68.55 in cash and $1.80 in certificates of indebtedness per cow.

The average amount of milk used by the operators' families was 2038 pounds per family. The milk kept at home amounted to 12 per cent of the total production, nearly three times as much, in proportion to the amount sold, as in the market-milk areas reported in preceding bulletins. The reason for this is that the cheese factories close in the fall and do not open again until spring, and the production of all the cows, of course, cannot be regulated to conform with these closing and opening dates.

The returns for milk products sold, and for milk and its products used on the farms, are given in table 37. The total amount of milk produced was 6,114,293 pounds. The average production per cow was 4971 pounds, of which 4348 pounds, or 88 per cent, was sold.

TABLE 37. RETURNS FROM MILK PRODUCTS SOLD AND MILK AND ITS PRODUCTS USED ON THE FARM

	Number of farms	Number of pounds of product	Total value
Milk products sold:			
Butter	11	1,072	$448
Milk sold retail	1	1,570	58
Milk used:			
Operators' families	67	136,555	$2,007
Hired men's families	2	1,822	26
Parent's family (father)	1	1,570	24
Landlord's family	1	785	11
Total milk used	67	140,732	$2,068
Milk products used:			
Butter:			
Family	34	2,590	1,074
Landlords' families	3	385	177
Skimmilk:			
Poultry	2	6,680	14
Hogs	23	55,960	131
Whey:			
Hogs	53	1,964,964	1,970
Total milk and its products used, except that fed to cattle	67	2,171,311	$5,434
Milk fed:			
Heifers	50	135,423	$1,911
Veals	51	377,885	5,070
Bull calves to be sold	1	1,120	15
Bull calves to be raised	15	10,670	135
Total milk fed to cattle	65	525,098	$7,131

TABLE 37 (*concluded*)

	Number of farms	Number of pounds of product	Total value
Milk products fed:			
Skimmilk:			
Heifers	8	25,493	$ 57
Veals	3	9,125	18
Bull calves to be raised	1	753	2
Whey:			
Heifers	8	107,740	114
Veals	2	54,000	49
Bull calves to be raised	2	1,700	2
Total milk products fed to cattle	19	198,811	$242
Total milk and milk products fed to cattle	66	723,909	$7,373
Equivalent, in pounds of milk, of milk and its products used	67	2,895,220	....

The average yield of the cows during the stabling period was 2050 pounds, or 10 pounds per day, and during the pasture period 2921 pounds, or 18.1 pounds per day.

The returns from all milk not sold to the factory averaged $9.09 per cow.

Calves born during the year

Of the calves born during the year, 4.7 per cent were born dead. Of the cows on hand at the end of the year, 2.7 per cent failed to breed, and 6.4 per cent had unsound quarters.

The average value of calves at birth was: purebred heifers, $12.87; grade heifers, $2.23; calves vealed or to be vealed, $1.73 (table 38). Of the total calves born, 83 per cent were vealed or deaconed. The returns from calves and calf hides averaged $1.81 per cow, or 4 cents per 100 pounds of milk produced.

TABLE 38. NUMBER OF CALVES BORN DURING THE YEAR, AND THEIR VALUE AT BIRTH

	Number of farms	Number of calves	Per cent	Value	Value of each at birth
Heifers to be raised or sold:					
Purebred	7	15	1.3	$193	$12.87
Grade	50	163	14.1	364	2.23
Bulls to be kept:					
Purebred	1	1	0.1	15	15.00
Grade	13	14	1.2	28	2.00
Bulls sold or to be sold:					
Purebred	1	1	0.1	10	10.00
Grade	2	2	0.2	3	1.50

TABLE 38 (*concluded*)

	Number of farms	Number of calves	Per cent	Value	Value of each at birth
Calves vealed or to be vealed	66	919	79.6	$1,593	$1.73
Calves deaconed	14	39	3.4	......	....
Deacon hides	7	(26)	......	16	0.62
Total calves born alive*	67	1,154	100.0	$2,222	$1.93
Live calves per 100 cows	......	94	......	......	....
Calves born dead	35	57	......	......	....
Dead calf hides	3	(5)	......	6	....
Total credited to cows	......	......	......	$2,228	....
Cows that aborted	1	1	......	......	....
Cows that would not breed	16	33	......	......	....
Cows with unsound quarters	37	79	......	......	....

* The total number of calves exceeds the number of cows calving by one, because of twins.

Manure

The average value of manure per ton at the barnyards was $1.40. It was credited to cattle at this value. The average amount credited was 6.3 tons, valued at $8.80 per cow. This was 20 cents per 100 pounds of milk sold, or 18 cents per 100 pounds of milk produced.

TABLE 39. MANURE RECOVERED FROM CATTLE AND HORSES

	All stock	Cows	Heifers	Herd bulls	Bull calves to be sold	Veals	Horses
Manure recovered (tons)	11,666	7,731	1,295	427	5	2	2,206
Value at $1.40 per ton at the barnyard	$16,332	$10,826	$1,811	$590	$6	$3	$3,096

SUMMARY OF COSTS AND RETURNS

The costs and returns for the dairy enterprises on these 67 farms are given in table 40. For the reason that a large proportion of the milk is kept at home, the costs and returns are computed in three ways: (1) per 100 pounds of milk sold; (2) per 100 pounds of milk for 95 per cent of the milk produced, this being the approximate percentage sold in areas producing market milk; and (3) per 100 pounds of milk produced. The net cow cost of producing all milk was $2.14 per 100 pounds, and the herd cost was $2.23 per 100 pounds. The average returns per 100 pounds of milk were $1.63, excluding the returns from calves and calf hides, and from manure. The

difference, therefore, between the costs and the returns, was minus 51 cents per 100 pounds of milk produced.

With concentrates at $36.77, silage at $6.76, and dry forage at $14.08, per ton, and labor at 23 cents per hour, the average loss was $36.27 per cow. However, after all charges except those for labor were met, the returns in milk production were 2 cents per hour for all time spent on the enterprise.

TABLE 40. SUMMARY OF COSTS AND RETURNS, 1230 COWS

	Per cow	Per 100 pounds of milk sold	Per 100 pounds for 95 per cent of the milk produced	Per 100 pounds of milk produced
Costs:				
Concentrates	$17.00	$0.39	$0.36	$0.34
Succulent feed	13.12	0.30	0.28	0.27
Dry forage	27.34	0.63	0.58	0.55
Pasture	10.11	0.23	0.21	0.20
Bedding	1.35	0.03	0.03	0.03
Human labor	30.37	0.70	0.64	0.61
Horse labor	1.09	0 03	0.02	0.02
Hauling milk	7.02	0.16	0.15	0.14
Use of buildings	6.78	0.16	0 14	0.14
Use of equipment	1.43	0 03	0.03	0.03
Interest on cows	3.62	0.08	0.08	0.07
Depreciation on cows (net)	2.99	0 07	0.06	0.06
Bull service	3.59	0.08	0.08	0.07
Miscellaneous	2.26	0.05	0.05	0.05
Total costs	$128.07	$2 94	$2.71	$2.58
Returns:				
Milk sold	$68.55	$1.58	$1.45	$1.38
Certificates of indebtedness	1.80	0.04	0.04	0.03
Milk retailed and milk products sold	0.41	0.01	0.01	0 01
Milk and milk products used, except that fed to cattle	2.82	0.06	0.06	0.05
Milk and milk products fed to cattle	5.86	0.14	0.12	0.12
Whey	1.74	0.04	0.04	0.04
Calves and calf hides	1.81	0.04	0 04	0.04
Manure	8.80	0.20	0.18	0.18
Miscellaneous	0.01	....	....	....
Total returns	$91 80	$2.11	$1 94	$1.85
Loss	$36.27	$0.83	$0.77	$0 73
Cow cost of producing milk	$106.62	$2.45	$2.26	$2.14
Herd cost of producing milk	......	$2.55	$2.34	$2.23

COST OF RAISING HEIFERS

The average number of heifers calving for the first time was 2.5 per farm. The average age at which these heifers freshened was 26 months, and the average value at the time of freshening was $46.15 for grades, $88.75 for

purebreds, and $48.17 for all. The average value of cows was $60 per head. Data showing the number and the value of heifers freshening for the first time at various ages are given in table 41:

TABLE 41. Age of Heifers Freshening for the First Time, and Their Value

Age (months)	Number of heifers	Value
18	1	$ 35
20	1	25
21	1	50
22	4	195
24	94	4,715
25	4	150
26	16	770
27	10	470
28	9	315
30	15	720
36	14	695
Total	169	$8,140

The cost of raising a heifer to two years of age was $91.80 (table 42). The approximate cost of raising a heifer till time of freshening was $100, or more than twice as much as the value placed on the heifer.

An average of 668 pounds of whole milk, 126 pounds of skimmilk, and 532 pounds of whey, was used by heifers in addition to 399 pounds of concentrates, 1.8 tons of silage, and 2 tons of dry forage (table 42).

TABLE 42. Cost of Raising Heifers

	Total		
	Amount	Value	Amount per cattle unit
Costs:			
Whole milk	135,423 pounds	$1,911	668 pounds
Skimmilk	25,493 pounds	57	126 pounds
Whey	107,740 pounds	114	532 pounds
Concentrates	809 cwt.	1,909	399 pounds
Silage	365.8 tons	2,476	3,609 pounds
Hay	364.7 tons	5,768	3,598 pounds
Other dry forage	50.6 tons	325	499 pounds
Pasture	....	1,583	....
Bedding	42.7 tons	306	421 pounds
Human labor	13,444 hours	3,148	66 hours
Horse labor	1,297 hours	200	6 hours
Use of buildings	....	1,271	....
Use of equipment	....	416	....
Interest on stock	....	566	....
Miscellaneous	....	15	....
Total costs	....	$20,065	....

TABLE 42 (*concluded*)

	Total		
	Amount	Value	Amount per cattle unit
Returns:			
Appreciation	....	$8,680	....
Manure	1,295 tons	1,811	6.4 tons
Total returns	....	$10,491	....
Difference (loss)		$9,574	
Value at birth, plus purchases, less sales, hides, and those eaten		$353	
Cost of raising a heifer to two years of age:			
Total		$18,607	
Per cattle unit		$91.80	
Number of cattle units		202.7	

FALL OR SPRING FRESHENING

On these farms only 4.6 per cent of the cows freshened from September to December, inclusive. Therefore no grouping of the records into fall or spring dairies is possible. The distribution of the cows freshening by months is shown in table 43:

TABLE 43. COWS FRESHENING BY MONTHS

	Number	Per cent
1921:		
May	58	4.8
June	23	1.9
July	14	1.2
August	1	0.1
September	6	0.5
October	7	0.6
November	10	0.8
December	33	2.7
1922:		
January	68	5.6
February	169	13.9
March	499	41.2
April	323	26.7
Total	1,211	100.0

There is very little question as to which system is the better with the cheese-factory market. The success of a dairy farm with this market depends on efficiency in the use of hay and pasture. The herd should be milking when the cheese factories open, and yet the cows should not freshen too far in advance of this date because of the difficulty of disposing of the milk.

It is questionable whether the use of silage is of great advantage in this area, where there is no good market for milk in the winter.

The ages of the cows are given in table 44. There are a large number of old cows in this area; 22.6 per cent are more than eight years old, as compared with 11.9 per cent in the Tully and Homer area.[4] With such an

TABLE 44. AGES OF 1237 COWS ON HAND APRIL 30, 1922

Age (years)	All herds	
	Number	Per cent
2– 3	155	12.5
3– 4	189	15.3
4– 5	172	13.9
5– 6	165	13.3
6– 7	122	9.9
7– 8	155	12.5
8– 9	106	8.6
9–10	69	5.6
More than 10	104	8.4
Total	1,237	100.0

extensive system, the economic necessity for the close weeding-out of low producers is not so great as it is in an intensive market-milk area, where the losses would be much greater with an inefficient animal.

FERTILITY MAINTENANCE

The use of fertilizer and lime is summarized in tables 45 and 46:

TABLE 45. SUMMARY OF USE OF FERTILIZER AND LIME

Forms of fertilizer and lime	Number of farms using	Acres fertilized	Total pounds used	Pounds per acre fertilized	Cost
For oats:					
Sodium nitrate	1	13	4,050	....	$172
Acid phosphate	1	15	3,000	....	45
Total fertilizer	2	28	7,050	252	$217
For wheat:					
Sodium nitrate	1	3	950	....	$40
Total fertilizer	1	3	950	317	$40
For barley:					
Ground limestone	1	0.5	1,000	....	$2
Total lime	1	0.5	1,000	2,000	$2

[4] Bulletin 433 of this experiment station, page 101.

TABLE 46. TOTAL FERTILIZER AND LIME USED

Forms of fertilizer and lime	Pounds used	Per cent of total
Fertilizer:		
Sodium nitrate	5,000	62.5
Acid phosphate	3,000	37.5
Total fertilizer	8,000	100.0
Lime:		
Ground limestone	1,000	100.0
Total lime	1,000	100 0

Only three farms purchased any commercial fertilizer, and the total amount purchased averaged $3.84 for all farms. This was used on oats, wheat, and barley. For the 67 farms, $2 only was expended for ground limestone. The use of lime is not necessary in this region because the soil is heavy and produces good crops of grain and clover without it. The income on these dairy farms is so small that the farmers cannot afford to buy commercial fertilizer.

Of the total manure used, 22.5 per cent was applied for the corn crop, 10.6 for oats, 3.7 for other grain, 55.5 for new seeding, and the remaining 7.7 per cent for other crops. The amount of manure recovered amounted to an average of 1.6 tons per acre in crop land, but on a few farms manure was piled by tenants for their successors. The average rate of spreading manure was 12.6 tons per acre for corn for the silo, 9 tons on new seeding, and 8 tons on old meadows. The average application of manure for all farms was 10 tons per acre manured. (Table 47).

TABLE 47. USE OF MANURE ON 67 FARMS

Crop	Number of farms using	Acres manured	Tons applied	Tons per acre manured	Per cent of tons applied
Corn for grain	5	18.5	228	12.3	2.0
Corn fodder	1	6	42	7.0	0.4
Corn stover	1	1	20	20.0	0.2
Corn for the silo	26	178.5	2,252	12.6	19.9
Oats	12	82	1,202	14.7	10.6
Oats and barley	3	30	232	7.7	2.1
Barley	1	5	75	15.0	0.7
Wheat	3	5.5	98	17.8	0.9
Hay, first year	49	696.5	6,269	9.0	55.5
Hay, old meadows	9	92.6	743	8.0	6.6
Potatoes	5	5.8	84	14.5	0.7
Pasture	1	5	46	9.2	0.4
Total	....	1,126.4	11,291	10.0	100.0
Not used	5	....	375	....	....

LABOR DISTRIBUTION

Since most of the cows freshen in the spring, the distribution of the labor on cattle is different from that for market-milk production. No data showing the proportion of labor in each month under such a system are available. For the year, however, 60 per cent of the work units, excluding labor on horses, were for cattle, 7 per cent were for cultivated crops, 12 per cent were for grain and annual hay crops, 15 per cent were for hay, and 6 per cent were for all else. With the heavy milking in summer, and with spring grain and hay as the chief crops, this labor distribution is not good; there is more work in summer than in winter. How to provide winter work is a real problem. Shipping markets for milk are not available, and the distance to egg and poultry markets places this enterprise at a disadvantage. This disadvantage, however, is largely offset by cheap milk and whey. A few farms are combining the poultry enterprise with that of production of milk for the cheese factory, and this appears to be a wise combination.

SUMMARY OF AVERAGES

The more important business-analysis averages are given in table 48, and the business factors for each of the 67 farms are given in table 49.

TABLE 48. SUMMARY FOR COMPARING INDIVIDUAL FARMS WITH THE AVERAGES FOR 67 FARMS

	Average for 67 farms	Individual farms
Year of record, ending April 30	1922	....
County	Jefferson	....
Labor income	-$374	....
Size of business:		
1. Productive man-work units	489	....
2. Acres of crops	108.7	....
3. Acres pastured (woods in equivalent of open pasture)	71.1	....
4. Number of cows, average	18	....
5. Number of men, including operator	1.92	....
6. Capital	$13,909	....
7. Hundredweight of milk sold per farm	798	....
8. Animal units per farm:		
Including work animals	27.7	....
Excluding work animals	23.7	....
Type of business:		
9. Average miles to milk station	1.4	....
10. Per cent of total productive man-work units on:		
Cattle	60.3	....
Cultivated crops	7.1	....
Grain crops and peas	11.9	....
Hay	15.0	....
All else	5.7	....
11. Total productive man-work units on farm per acre of crops	4.5	....
12. Per cent of capital in:		
Real estate	77	....
Livestock	14	....
Equipment and supplies	9	....
13. Per cent of cows freshening from September to December, inclusive	4.6	....

TABLE 48 (*continued*)

	Average for 67 farms	Individual farms
Type of business (*concluded*):		
14. Per cent of milk sold during:		
May, June, July	45.1	....
August, September, October	30.8	....
November, December, January	8.4	....
February, March, April	15.7	....
15. Average weight of cows (pounds)	824	....
16. Average weeks cows are dry	9.2	....
17. Per cent of cows less than four years old	27.8	....
18. Per cent of cows replaced	15.1	....
19. Per cent of cows added that were raised at home	84.7	....
20. Per cent of cows added that were purchased	15.3	....
21. Average age of heifers when freshening for first time (months)	26.0	....
22. Grade of milk	Cheese	....
23. Per cent of milk produced which is sold	87.5	....
24. Per cent of milk kept at farm	12 5	.....
Balance of business:		
25. Pasture acres per animal unit pastured	2 9	.....
26. Acres of crops per animal unit	3 9	.....
27. Manure per acre of crops (tons)	1.6	....
28. Manure applied per acre of crops receiving manure (tons)	1.5	....
29. Value of purchased fertilizer per acre of crops	$0.04	....
30. Labor distribution (good, fair, poor)	Poor	....
31. Important sources of income, and receipts from each, per farm:		
Milk	$1,299	....
Appreciation on cattle*	$207	....
Crops sold	$151	....
32.†		
33.†		
34. Per cent of receipts from crops	7.5	.....
Rates of production:		
35. Crop index, all crops (based on average yields for New York State)	56.3	....
36. Crop index:		
Corn for the silo	132.8	....
Oats (threshed)	60.3	....
Hay	48.9	......
37. Pounds of milk produced per cow	4,971	....
38. Pounds of milk sold per cow	4,348	....
39. Pounds of milk produced per dollar invested in cows	82	....
40. Value of milk and its products sold per cow	$71	....
41. Appreciation on cattle per cattle unit	$9 24	....
Labor efficiency:		
42. Productive man-work units per man	255	....
43. Acres of crops per man	56.6	....
44. Animal units, except work animals, per man	12.3	....
45. Productive horse-work units per work animal	64	....
46. Acres of crops per work animal	27.5	....
47. Labor returns per man	122	....
48. Labor returns per man-work unit	0.48	....

* Includes value of calves born during the year.
† The data for these items are not computed for this study, but the numbers are included here in order to facilitate comparison with corresponding tables in other publications of this series.

TABLE 48 (*continued*)

	Average for 67 farms	Individual farms
Labor efficiency (*concluded*):		
49. Per cent of farms using milking machines	34	....
50. Per cent of months machines are used	54	....
51. Hundredweight of milk produced per man	476	....
Human labor:		
Hours per cow per year:		
52. Milking	67	....
53. Hauling milk	14	....
54. Other labor	65	....
Hours per 100 pounds of milk produced:		
55. Pasture season	1.8	....
56. Winter	4.5	....
57. For year	2.9	....
Capital efficiency:		
58. Value of crop land per acre	\$39.71	....
59. Value of pasture land per acre	\$22.77	....
60. Value of woodland per acre	\$15.82	....
61. Value of houses per farm	\$1,733	....
62. Value of cattle barns per farm	\$1,842	....
63. Value of other buildings per farm	\$978	....
64. Per cent of real-estate capital in buildings	42.4	....
65. Per cent of real-estate capital in land	57.6	....
66. Value of machinery and equipment per acre of crops	\$10.68	....
Feeding efficiency:		
Feed:		
Per cow per year:		
67. Concentrates (pounds)	913	....
68. Silage (pounds)	3,775	....
69. Other succulent feed (pounds)	140	....
70. Dry forage (pounds)	4,004	....
71.†		
72.†		
73. Days of pasture per cow	161	....
Per cow per day during winter:		
74. Concentrates (pounds)	4.3	....
75. Silage (pounds)	17 9	....
76. Other succulent feed (pounds)	....	....
77. Dry forage (pounds)	19.3	....
78.†		
79.†		
80.†		
Per 100 pounds of milk produced in pasture period:		
81. Days of pasture	5.5	....
82. Concentrates (pounds)	1.4	....
83. Silage and other succulent feed (pounds)	8.8	....
84. Dry forage (pounds)	2.3	....
Per 100 pounds of milk produced in winter period:		
85. Concentrates (pounds)	42.5	....
86. Silage (pounds)	178.5	....
87. Other succulent feed (pounds)	....	....
88. Dry forage (pounds)	192.1	....
89.†		
90.†		
Per 100 pounds of milk produced thru the year:		
91. Concentrates (pounds)	18.4	....

† The data for these items are not computed for this study, but the numbers are included here in order to facilitate comparison with corresponding tables in other publications of this series.

TABLE 48 (*concluded*)

	Average for 67 farms	Individual farms
Feeding efficiency (*concluded*):		
Feed (*concluded*):		
Per 100 pounds of milk produced thru the year (*cont'd*):		
92. Silage (pounds)	75.9	....
93. Other succulent feed (pounds)	2.8	....
94. Dry forage (pounds)	80.6	....
95.†		
96.†		
Costs and returns for cows:		
97. Total costs per cow	$128	....
98. Returns, exclusive of milk sold	$21	....
99. Cost of milk sold per cow	$107	....
100. Value of milk sold, cash per cow	$69	....
101. Certificates of indebtedness, per cow	$2	....
102. Gain or loss per cow (Loss)	$36	....
103. Price received per 100 pounds of milk sold	$1.62	....
104. Cost of producing 100 pounds of milk	$2.45	....
105. Loss per 100 pounds of milk	$0.83	....
Cost of raising a heifer:		
106. To two years of age	$92	....
107. To age of freshening (approximate)	$100	....

† The data for these items are not computed for this study, but the numbers are included here in order to facilitate comparison with corresponding tables in other publications of this series.

TABLE 49. IMPORTANT BUSINESS FACTORS FOR 67 LA FARGEVILLE FARMS

(Arranged according to size of farm operated)

Farm no.	Acres operated	Acres of crops	Number of cows	Average total capital		Man equivalent	Milk sales	Crops sales	Farm expenses	Operator's labor income		Landlord's return on investment (per cent)	
				Operator	Landlord					Plus	Minus	Plus	Minus
481..	100	74.5	10	$ 1,430	$10,037	1.2	$ 852	$ 306	$ 621	$ 149	...	6.1	...
507..	115	85	13	2,580	7,881	1.5	730	...	1,074	279	...	4.1	...
491..	116	68.7	12	638	7,555	1.8	792	4	958	...	$ 50	...	0.2
474..	118	82	14	10,068	...	1.3	914	...	460	256	...	...	...
492..	118	87	14	12,313	...	2.3	825	...	1,346	...	953	...	...
515..	125	66	16.5	7,806	...	1.9	2,270	...	1,804	164	...	...	...
527..	126	87.5	11.5	1,014	9,730	1.6	833	600	794	668	...	2.3	...
501..	134	62.5	12.5	10,963	...	1.8	844	120	1,182	...	589	...	...
490..	137	72	13	12,478	...	1.4	1,183	...	779	...	197	...	...
471..	140	50	12	810	3,391	1.2	585	...	643	...	80	3.0	...
506..	140	94	12.5	1,131	7,606	1.2	777	17	923	69	...	2.2	...
470..	140	70	13	9,780	...	1.2	872	20	582	380	...	...	...
511..	141	64.5	14.5	12,786	...	2.1	611	31	1,128	...	986	...	...
519..	143	93	13	2,574	7,500	1.1	973	...	1,222	...	379	3.8	...
512..	149	82.5	14	1,333	14,786	1.7	879	...	1,535	...	37	1.9	...
526..	149	73.5	12.5	8,780	...	2.5	995	...	1,663	...	871	...	...
497..	153	117.5	11	1,483	12,584	2.3	642	...	1,571	...	1,040	1.7	...
466..	155	68.3	13.5	8,722	...	1.2	1,109	...	799	124	...	...	...
473..	157	89	13.5	1,385	5,939	1.8	695	90	745	33	...	5.6	...
495..	160	93	22	1,344	9,315	1.4	1,085	...	836	82	...	4.4	...
488..	164	97.5	18.5	9,950	...	1.9	1,208	26	1,112	...	178	...	...
475..	168	94	16	1,128	8,508	1.2	887	...	1,677	206	...	1.8	...
479..	172	83	20	914	7,715	2.0	904	8	1,309	...	330	1.4	...
509..	173	85	20	13,982	...	1.7	1,671	...	1,043	...	110	...	...
508..	177	118.5	19	2,288	13,726	2.1	1,578	...	1,014	...	101	3.0	...
522..	178	85.5	14	2,028	7,579	2.2	553	...	2,310	...	463	2.1	...
498..	180	66	14.5	13,636	...	3.1	797	340	4,798	...	1,520	...	...
477..	181	95	19	13,590	...	2.0	2,006	380	1,616	...	188	...	...
500..	183	144	16	4,052	14,544	1.6	755	274	1,401	415	...	...	0.2

494..	184	96	17	1,000	10,092	2.0	1,065	285	1,156	...	237	4.5	...
493..	184	103.5	15.5	16,156	...	2.1	1,609	450	1,718	...	751	...	...
472..	185	106	17.5	3,152	9,764	2.1	1,028	590	1,279	...	600	8.8	...
486..	186	77.5	17.5	1,410	9,120	2.2	982	280	1,142	...	82	4.4	...
518..	190	84	12.5	15,917	...	1.6	1,359	200	1,051	367	...	...	...
480..	190	73.5	17	1,512	12,298	3.0	885	...	1,785	...	1,283	1.8	...
504..	190	82	20	1,518	10,620	1.1	1,139	...	948	...	114	3.3	...
483..	195	127	18.5	1,818	16,538	2.3	809	...	2,073	...	1,193	...	0.1
476..	198	70.5	13.5	10,060	...	2.6	753	...	2,085	...	1,724	...	...
485..	200	110	16.5	938	11,145	1.3	734	...	868	35	...	1.7	...
487..	200	65.5	10	1,612	8,333	1.1	667	75	535	499	...	4.2	...
520..	200	111	16	2,627	10,754	1.2	1,096	...	945	...	500	2.2	...
532..	202	110.5	25	1,978	15,537	2.3	1,803	100	1,413	...	308	4.7	...
525..	206	116	29.5	2,550	12,322	1.8	2,239	480	1,439	...	83	10.3	...
505..	206	135	15.5	17,706	...	2.2	1,802	320	1,372	...	641	...	...
499..	207	92.5	16.5	1,786	7,954	1.4	1,389	...	1,018	215	...	4.3	...
489..	208	77.5	16.5	1,240	10,367	1.0	1,674	15	348	671	...	7.0	...
482..	210	132	17.5	7,336	8,750	1.3	1,205	960	953	1,239	...	3.5	...
496..	223	133	21	2,102	12,945	1.8	1,120	75	2,406	1,072	...	16.1	...
523..	228	92	25.5	20,854	...	2.2	1,854	45	2,467	...	1,065	...	...
510..	230	128.5	20.5	1,976	8,988	1.8	1,290	...	4,500	...	459	14.9	...
524..	230	145.3	18	8,536	5,000	2.1	1,294	450	1,722	...	148	3.9	...
484..	240	130	17.5	2,334	10,530	1.2	2,202	...	2,287	382		6.2	...
521..	240	133	19	17,448	...	2.2	1,396	302	1,617	...	520		...
513..	243	119	15.5	14,352	...	2.0	1,453	...	2,085	...	817	...	...
516..	250	104	13.5	12,240	...	2.0	556	...	1,246	...	928	...	...
468..	251	182.7	10.5	24,616	...	2.9	675	1,315	5,027	...	552		...
530..	265	176.5	25	1,681	16,438	2.4	1,440	...	2,295	...	650	1.6	...
467..	275	123.5	31.5	1,668	9,948	1.9	2,243	14	2,709	...	812	4.9	
469..	276	167.5	19.5	24,650	...	3.4	1,360	916	3,292	...	1,318	...	...
528..	283	208	19.5	13,401	2,500	1.7	1,416	424	1,703	...	825	11.4	...
502..	300	110.8	43	10,930	10,800	2.8	5,919	...	4,364	1,110	...	4.4	...
514..	301	183	36	1,944	18,290	1.7	2,485	...	1,669	...	118	1.9	...
517..	343	172	26.5	3,800	21,374	2.2	1,607	620	2,596	...	586	4.2	...
478..	350	95	19.5	1,724	10,231	1.1	1,514	...	913	83	...	5.6	...
503..	366	207.3	49.5	2,436	19,558	3.0	1,962	...	2,473	...	951	1.5	...
531..	420	279	25	11,548	12,295	3.1	1,498	4	3,319	...	2,640	3.3	...
529..	467	176	37	31,458	...	3.8	2,186	...	2,892	...	1,025	...	...

SUCCESSFUL FARMS

Of the 67 farms, 6 made farm-labor incomes of more than \$500 and 3 made more than \$1000. Some important factors for all farms making labor incomes of more than \$800 are given in table 50:

TABLE 50. BUSINESS FACTORS FOR SOME SUCCESSFUL FARMS WITH CASH CROPS, FOR THE YEAR ENDING APRIL 30, 1922

Farm no. County Village	482 Jefferson Alexandria Bay	489 Jefferson Limerick	496 Jefferson La Fargeville	502 Jefferson La Fargeville
Operator's labor income	\$1,239	\$671	\$1,072	\$1,110
Landlord's return on investment (per cent)	3.5	7.0	16.1	4.4
Cost of milk per 100 pounds produced	\$1.83	\$1.73	\$1.21	\$2.12
Cost of milk per 100 pounds sold	\$2.14	\$1.84	\$1.39	\$2.27
Price received for milk	\$1.52	\$1.55	\$1.33	\$2.26
Gain or loss per cow:				
Gain	....	....	....	....
Loss	\$28 23	\$19.21	\$2.10	\$0.79
Size of business:				
Acres operated	210	208	223	300
Acres of crops	132	77.5	133	110.8
Number of cows	17.5	16.5	21	43
Number of men, including operator	1.3	1.0	1.8	2.8
Capital:				
Landlord	\$8,750	\$10,367	\$12,945	\$10,800
Operator	\$7,336	\$1,240	\$2,102	\$10,930
Hundredweight of milk sold per farm	793	1,080	840	2,623
Type of business:				
Milk receipts	\$1,225*	\$1,674	\$1,120	\$5,919
Crop sales:	(\$960)	(\$15)	(\$75)	
Potatoes	....	\$15	....	....
Oats	....	....	\$75	....
Hay	\$960	....	....	....
Per cent of cows freshening from September to December, inclusive	0	0	0	9.3
Per cent of cows less than four years old	5.6	11.8	18.1	32.6
Acres of crops per animal unit	5.7	3.0	4.6	1.9
Rates of production:				
Pounds of milk produced per cow	5,300	6,965	4,571	6,541
Crop yields:				
Corn for the silo (tons)	....	....	....	9.6
Oats (bushels)	25	....	24.2	....
Alfalfa (tons)	....	1.5	....	....
Other hay (tons)	1.2	1	0.4	0.8
Potatoes (bushels)	....	60	....	125
Oats, speltz, and wheat (bushels)	....	....	....	31.8
Oats and barley (bushels)	....	27.4	....	....

* This value includes \$20 for butter sold.

TABLE 50 (*concluded*)

Farm no.	482	489	496	502
County	Jefferson	Jefferson	Jefferson	Jefferson
Village	Alexandria Bay	Limerick	La Farge-ville	La Farge-ville
Feeding:				
Pounds of concentrates per cow	577	1,400	814	1,098
Pounds of silage and other succulent feed per cow	1,714	970	....	8,186
Pounds of dry forage per cow	7,886	6,303	3,619	2,186
Price per ton for concentrates	$31.09	$25.02	$30.99	$40
Acres of crops grown:				
Corn for the silo	....	....	....	23
Oats	20	....	33	....
Alfalfa	....	8	....	....
Other hay	110	32	100	65
Potatoes	....	0.5	....	0.8
Oats, speltz, and wheat	....	....	....	22
Oats and barley	....	32	....	....
Corn for fodder	....	5	....	....

Farm no. 496, share-operated, yielded the highest returns, the tenant's labor income being $1072 and the landlord's return on capital 16.1 per cent. The landlord's capital was $12,945 and the tenant's capital was $2102. Cordwood was the cash crop, 900 cords being sold for $3.50 a cord. There were 21 cows kept and 14 calves fatted. Milk receipts amounted to $1120, of which the tenant and the landlord each received half. If the farm value were decreased by the amount of wood sold, the labor income and the interest returns would likewise be less.

Farm no. 482 comprised 210 acres, of which 75 acres were owned by the operator, and 135 acres, with 9 cows and 1 horse, were cash-rented for $350. Besides the milk sales, amounting to $1205, 60 tons of hay were sold for $960. No grain was purchased, but 5 tons of home-grown oats were fed to the cows. The average milk production was 5300 pounds per cow. The labor income of the operator was $1239, and the landlord's return on the cash-rented land and livestock was 3.5 per cent.

Farm no. 489 is a one-man share-rented dairy farm of 208 acres, and has 17 cows. Milk sales were $1674. No grain was purchased. The landlord's capital amounted to $10,367, and the tenant's capital to $1240. The tenant's labor income was $671, and the landlord's return on the capital was 7 per cent.

Farm no. 502 comprised 104 acres owned by the operator, and two additional cash-rented parcels, one of 96 acres and one of 100 acres. There were 43 cows kept, and the milk was delivered to a shipping station during part of the year. Milk receipts amounted to $5919, and appreciation on cattle, and value of calves born, to $314. One man was hired for the year, and another for eight months, and one month of day help was hired. The feed bill was $811. The operator's labor income was $1110, and the landlords' net return on their capital was 4.4 per cent. The success of the

enterprise is due to the large volume of business and to the shipping-station price for milk. If fluid-milk markets were located in this area, many of the farmers would be able to make good labor incomes, because much of their grain could be home-grown.

Very few farmers in this area are getting ahead financially. Few farms are sold. The disappearance of hay markets with the coming of motor transportation has taken from these farmers their only cash crop. This means that the system of farming must be changed. When there is an opportunity to ship milk, it will be time to shift to fall dairying. However these farmers have plenty of level land for the production of good crops of oats and barley, and they have cheap milk — two decided advantages for raising cattle. In addition to raising enough animals to replace their herds, they might raise heifers to freshen in the fall. These could be shipped to market-milk areas. Such heifers would not sell to advantage as two-year-olds; but if calves were fatted on their milk the first year, they would sell as three-year-olds. To make such a change successful, a large number of operators would need to raise heifers in order to develop a community reputation for good young animals.

Preceding publications on dairy farming by the same author, from the New York State College of Agriculture, are:

Calculating the cost of milk production. Reading-Course Lesson for the Farm, No. 142. 1919.

An economic study of dairying on 149 farms in Broome County, New York. Cornell Univ. Agr. Exp. Sta., Bulletin 409. 1922.

Relation of the composition of rations on some New York dairy farms to the economics of milk production. Cornell Univ. Agr. Exp. Sta., Memoir 64. 1923.

Economic studies of dairy farming in New York. I. Condensery milk without cash crops. Cornell Univ. Agr. Exp. Sta., Bulletin 421. 1923.

An economic study of dairying on 163 farms in Herkimer County, New York. Cornell Univ. Agr. Exp. Sta., Bulletin 432. 1924.

Economic studies of dairy farming in New York. II. Grade A milk with and without cash crops. Cornell Univ. Agr. Exp. Sta., Bulletin 433. 1924.

Economic studies of dairy farming in New York. III. Grade B milk with alfalfa roughage. Cornell Univ. Agr. Exp. Sta., Bulletin 438. 1925.

Economic studies of dairy farming in New York. IV. Grade B milk with cash crops and mixed hay roughage, crop year 1921. Cornell Univ. Agr. Exp. Sta., Bulletin 441. 1925.

Bulletin 443

October, 1925

The Marketing of Cabbage

E. G. Misner

In cooperation with the Bureau of Agricultural Economics of the United States Department of Agriculture

CABBAGE RECORD BOOKS KEPT FOR THIRTY YEARS BY F. N. SALISBURY AT LITTLE YORK NEW YORK

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CONTENTS

THE MARKETING OF CABBAGE

E. G. MISNER[1]

Cabbage is a cheap, bulky, perishable vegetable. In the fall it is shipped from New York into the southern States. In late winter it is shipped from Florida to New York. Until a few years ago, the marketing of the crop was accomplished without wide dissemination of reports on the condition of the growing crop, the storage holdings, or the crop movement. Efficient production and marketing require information on all of these questions, so that producer and merchant may each obtain his fair share of the reward for such services and so that the price paid by the consumer may be adjusted to the service.

PARTIES ENGAGED IN THE BUSINESS OF MARKETING CABBAGE

At least ten classes of agents are concerned with the production, transportation, and marketing of cabbage. They are: (1) the producer, who grows the cabbage and transports it from the farm to the shipping point, and who sometimes stores part of the crop also; (2) the loading agent, who acts as an agent for another party in the purchasing, storing, or shipping of the cabbage, and who usually operates on a commission basis, none of his own money being as a rule invested; (3) the country shipper, who may also be owner or part owner of storehouses, and who provides for shipping cabbage to the cities on his own account; (4) the transportation company, which provides the cars and attends to the refrigeration and other details of the transportation from the country shipping point to the city; (5) the broker, who acts as the selling agent in the city, usually receiving a fee of $10 per car lot; (6) the commission merchant, who receives shipments of cabbage on consignment and sells them for a percentage of the returns; more of the southern cabbage which arrives in packages is disposed of in this way, than of the late car-lot bulk stock received from this State; (7) the joint-account city buyer, who sells cabbage received from the country shipper with whom he is operating the joint account; (8) the jobber, who purchases the cabbage from the broker, the commission merchant, or the joint-account seller, and disposes of it directly to the consumer or the retail man in small lots, either in bulk, sacks, barrels, or crates; (9) the retailer, who sells to the consumer and is

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[1] This bulletin was prepared in the Department of Agricultural Economics and Farm Management of the New York State College of Agriculture at Cornell University, Ithaca, New York. To Mr. Frank N. Salisbury, of Little York, New York whose carefully kept books for thirty years of service as a purchasing and loading agent for various firms provide much of the material in this bulletin, the writer is greatly indebted, and extends his appreciation and thanks for the data and for the willingness to cooperate in making the facts available to the public. No other record of prices paid to growers by months for so many years is known to the author.

Much information contained in this bulletin was furnished by the main and branch offices of the Bureau of Agricultural Economics of the United States Department of Agriculture, and by various individuals. The copy for figures 1 and 2 was furnished by Reed Bros., of Cortland, New York, and that for figure 3 by the United States Department of Agriculture.

Bulletin 433 from this station contains results of a study of the organization of dairy farms, some growing cash crops, the most important of these crops being cabbage. The greatest financial gain in the production and disposal of cabbage cannot be made without information in regard to prices and markets, and therefore this bulletin has been prepared to accompany Bulletin 433. The growing and the marketing of a crop should be considered together.

thus the last link in the chain of persons engaged in the marketing process; he buys directly from the broker, the commission merchant, the joint-account seller, the jobber, or the producer; (10) the consumer, whose demand determines the final price at which the product can be sold.

COST OF MARKETING

Producer.— The producer, in addition to the costs of growing the crop, has a marketing charge which is the cost of loading the product and transporting it from his farm to the village storehouse or directly to the freight car. These costs vary with the conditions of loading, the size of the load, the type and condition of the road, the distance hauled, and the method of transportation — whether by motor truck or by horse-drawn vehicle.

Loading agent.— The loading of cabbage by an agent is usually arranged for on a commission basis. The regularity with which the cabbage is received at the shipping point provides continuous employment and enables the agent to operate on this basis to his own financial satisfaction. His expenses are chiefly the cost of visiting the farmers to make the purchases, and for the labor of placing the cabbage in the car.

Shipper.— The expense for lumber for bulkheads, for paper for lining, for heat while the car is being loaded, and for other costs incidental to preparing the car for shipment, is usually borne by the shipper by whom the agent is employed. In addition to these expenditures, the shipper bears the cost of shrinkage, direct labor and supervision, telephone and telegraph expenses, insurance, interest, taxes, and other overhead expenses accompanying a produce business. In some cases when a shipper does not own platform scales at the point of loading, there is a charge for weighing. Railroads are now beginning to install such scales at their stations. Many stations should have them, to permit farmers to do their own weighing for bulk feed purchased in car lots, and for produce shipped in car lots.

Transportation companies.— The expenses of the transportation companies include those for the refrigeration of cars, and for the placing of the cars at the point of origin and at the destination.

Brokers.— The broker's costs are those incidental to a city office: rent, telephone and telegrams, office help and other labor in addition to his own, and other selling expenses.

Commission merchants.— The expenditures of the commission merchant are the expenses of running the city office, those of maintaining salesmen at the piers or yards, and other selling expenses. The expense of transferring the cabbage from the piers to the trucks or to other vehicles used is charged to the shipper by the commission merchant.

Joint-account buyers.— The person who operates on a joint account with up-state buyers has an unloading expense and also the expense of sacking or barreling the produce, of heat for the car while unloading, of loss of weight in transit, of storing if it is necessary to hold the produce before selling, and of demurrage charges in case the car is not unloaded within the allotted time.

Jobbers.— The jobber's expense is self-evident: the cost of operating wagons or trucks or other vehicles for transporting the cabbage from the railroad yards to the retailers or consumers.

Retailers.— The expenses of the retailer are those of doing business, and those due to loss of the product from shrinkage and decay, uncollectible accounts, and so forth.

This report includes some mention of loading agents' charges, freight rates, and storage holding charges, but does not include details of the many items of expense incurred by the several parties to the business of marketing cabbage. These only a comprehensive cost study would bring out. It is purposed to emphasize the more general aspects of cabbage marketing in this bulletin, rather than the specific costs of marketing.

GRADES OF CABBAGE[2]

Cabbage is sold not by grade, but by type. When it is shipped in hampers, crates, barrels, or other containers, it is asier to hold rigidly to a grading system than when it is shipped in bulk car-lots, as is the late Danish cabbage from New York.

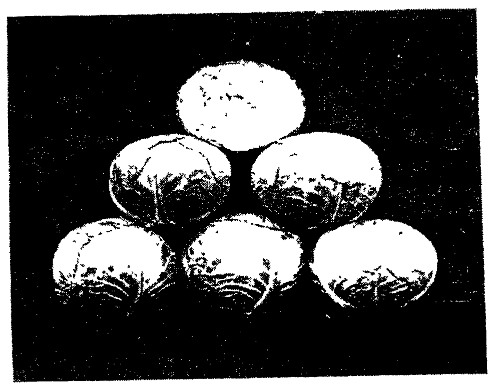


FIGURE I. A GOOD TYPE OF CABBAGE HEADS

The photograph shows the conical shape, the smooth, tight leaves overlapping well past the center, and the general firm, well-trimmed appearance, of this type of cabbage

The United States grades as revised and advocated in 1924 by the Bureau of Agricultural Economics are as follows:

U. S. No. 1 shall consist of heads of cabbage which are of one type, of reasonable solidity and well trimmed; which are not soft, withered, puffy, nor burst; which are free from soft rot, seed stems, and damage caused by discoloration, freezing, disease, insects, or mechanical or other means.

In order to allow for variations incident to proper grading and handling, not more than 10 per cent by weight of any lot may be below the requirements of this grade, but not to exceed one-fifth of this amount, or 2 per cent, may be allowed for decay.

U. S. No. 2 shall consist of heads of cabbage which do not meet the requirements of the foregoing grade.

In addition to the statement of grade, any lot may be classified as small, medium, large, small to medium, or medium to large, as follows:

	Small	Medium	Large
Pointed	Under 1½ pounds	1½ to 3 pounds	Over 3 pounds
Domestic	Under 2 pounds	2 to 5 pounds	Over 5 pounds
Danish	Under 3 pounds	3 to 6 pounds	Over 6 pounds

In order to allow for variations in size, not more than a total of 15 per cent, by weight, of any lot may vary from the size specifications, but not

[2] From a mimeographed report of the United States Bureau of Agricultural Economics.

more than 10 per cent may be either above or below requirements for each class. This tolerance is in addition to the tolerance for the grade.

The terms used in the description of these grades have the following meanings:

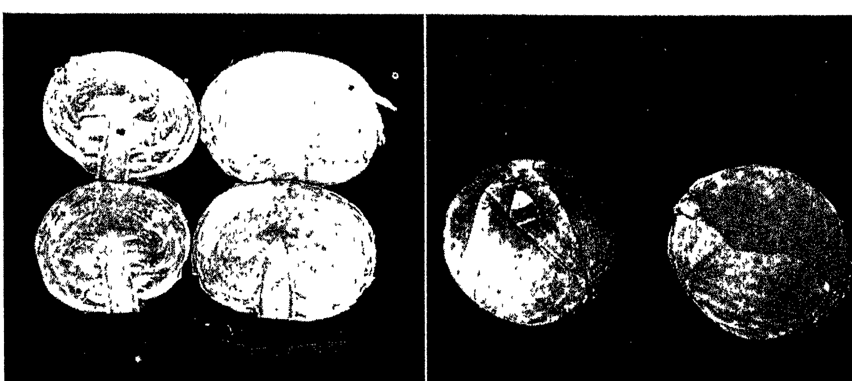
One type means that all the lot is Pointed, Danish, Domestic, Savoy, or Red, as the case may be. *Pointed type* includes such varieties as Early Jersey Wakefield, Charleston Wakefield, Early York, Winningstadt, and others which normally develop oblong, conical, or pointed heads. *Danish type* includes such late-maturing varieties as Danish Ballhead or Hollander, Danish Roundhead, and the like, and such early-maturing varieties as Cannonball, Danish Summer Ballhead, and the like, which normally develop hard, tight-leaved, compactly formed heads. A head of any such variety, even after trimming, will appear tight and smooth-leaved around the base, and, when viewed from the stem end, circular and regular in outline. *Domestic type* includes such varieties as Succession, All Head Early, Flat Dutch, and others which are commonly called Domestic and which normally develop heads flat in shape and less compactly formed than those of the Danish type. The term includes also such varieties as Copenhagen, Glory of Enkhuizen, and others which develop heads roundish in shape, but which in solidity of head and in storage qualities are similar to the Flat Domestic type

Reasonable solidity means fairly firm for Pointed type cabbage and southern Domestic type cabbage; northern Domestic type cabbage shall be firm, and Danish or Hollander type fairly hard.

Well trimmed means that the head shall have not more than four wrapper leaves attached, that any part of these leaves appreciably injured by worms or other means shall be removed, and that the stem shall be not longer than one-half inch.

Soft means loosely formed or lacking compactness.

Puffy means that the heads are very light in weight in comparison to size, and have air spaces in the central part. They normally feel firm at the time of harvesting, but soften quickly. They are known as " balloon heads " in certain sections.



A B

FIGURE 2. GOOD AND POOR TYPES OF CABBAGE

A, Contrasting the puffy, loosely formed head with the compact, well-shaped head of the better type
B, When wrapper leaves do not overlap, an opening is left

Seed stems means those heads which have seed stalks showing or in which the formation of seed stalks has plainly begun.

Free from damage means that the heads shall not be injured to an extent readily apparent on examination.

CABBAGE PRODUCTION IN THE UNITED STATES

ACREAGE AND PRODUCTION

Estimates of the acreage and of the production of the commercial cabbage crop in the principal producing States are shown in tables 1 and 2 as they have been reported by the United States Department of Agriculture. The production varies from about 500,000 to 1,000,000 tons, and the approximate December farm value from $14,000,000 to $41,000,000. The yield per acre was lowest, 6.5 tons, in 1917 and 1921, and highest, 9 tons, in 1915.

TABLE 1. COMMERCIAL ACREAGE OF CABBAGE, 1915 TO 1923*

State	Acres harvested								
	1915	1916	1917	1918	1919	1920	1921	1922	1923
Early:									
California	3,500	3,600	3,800	4,300	5,160	7,860	7,315	7,325	5,300
Florida	3,400	4,500	5,700	9,200	3,950	9,285	5,367	11,060	2,070
Louisiana	1,500	1,600	1,600	1,200	1,980	1,605	1,585	1,955	1,640
Texas	4,100	4,400	8,900	6,650	4,430	16,250	11,210	14,425	4,070
Total	12,500	14,100	20,000	21,350	15,520	35,000	25,477	34,765	13,080
Intermediate:									
Alabama	1,100	1,000	1,000	1,500	1,380	1,085	1,600	2,200	2,200
Georgia	.....	.....	.....	.....	.....	125	150	400	220
Illinois	325	375	235	225	170	1,605	1,325	975	1,400
Iowa	2,800	1,700	1,000	1,800	1,170	1,050	605	1,540	1,200
Kentucky	300	350	250	200	200	350	350	300	300
Maryland	1,565	1,584	340	180	470	2,185	2,055	2,750	2,000
Mississippi	1,200	1,200	2,100	2,600	1,450	1,810	1,365	4,460	4,240
Missouri	135	115	125	105	250	725	700	700	800
New Jersey	1,650	1,695	1,620	1,500	1,390	4,522	4,220	4,500	4,100
New Mexico	.....	.....	.....	.....	.....	200	130	268	300
New York (Long Island)	.....	.....	.....	.....	.....	4,550	4,150	4,500	4,200
North Carolina	500	550	350	400	280	308	450	350	440
South Carolina	2,300	2,300	3,100	3,500	2,060	1,993	3,968	5,148	3,450
Tennessee	250	275	300	310	420	575	655	1,430	1,200
Virginia (Norfolk, eastern shore)	4,750	5,050	4,350	3,050	2,475	2,840	4,195	4,500	3,750
Washington	165	185	175	260	260	1,026	920	950	890
Total	17,040	16,379	14,945	15,630	11,975	24,949	26,838	34,971	30,690
Late:									
Colorado	3,700	3,200	3,300	4,220	3,420	4,390	3,995	5,145	5,270
Indiana	1,300	1,100	1,300	1,400	830	1,240	1,090	1,335	1,300
Michigan	4,600	2,400	5,100	3,750	1,440	1,970	1,612	3,025	3,290
Minnesota	2,300	1,500	2,500	1,650	1,740	3,003	2,651	3,471	3,260
New York	35,900	17,800	28,300	28,000	20,120	26,597	22,895	24,895	22,680
Ohio	3,900	2,200	3,500	3,080	2,030	2,835	2,168	2,555	3,220
Oregon	175	200	195	275	275	820	775	900	900
Pennsylvania	650	555	350	275	320	2,905	2,720	2,805	2,750
Virginia (southwestern)	1,400	1,700	2,150	1,500	1,520	2,575	2,500	4,155	2,620
Wisconsin	13,500	9,200	11,800	11,500	8,660	15,137	10,540	16,575	13,340
Total	67,425	39,855	58,495	55,650	40,355	61,472	50,946	64,861	58,630
Grand total	96,965	70,334	93,440	92,630	67,850	121,421	103,261	134,597	102,400

* Data for the years 1915 to 1919, inclusive, are taken from the Yearbook of the United States Department of Agriculture for 1920, p. 671, 1921; for the years 1920 to 1922, inclusive, from the Yearbook for 1922, p. 763, 1923, for 1923, from *Weather, Crops, and Markets*, United States Department of Agriculture, vol. 4, p. 680, 1923, except the data for Long Island and both sections of Virginia, which were furnished by the Bureau of Agricultural Economics of the United States Department of Agriculture.

TABLE 2. COMMERCIAL PRODUCTION OF CABBAGE IN CAR LOTS CONTAINING 12.5 TONS EACH, 1915 TO 1923*

State	Production in carloads of 12.5 tons each								
	1915	1916	1917	1918	1919	1920	1921	1922	1923
Early:									
California	2,384	2,448	2,128	1,720	1,651	4,464	4,096	3,516	2,968
Florida	2,064	2,736	912	3,901	1,896	5,051	2,576	6,194	1,328
Louisiana	600	640	256	288	634	1,053	812	938	592
Texas	1,080	1,160	1,424	425	1,772	6,240	3,587	5,770	1,632
Total	6,128	6,984	4,720	6,334	5,953	16,808	11,071	16,418	6,520
Intermediate:									
Alabama	728	664	160	936	773	677	1,024	1,496	1,320
Georgia	......	......	......	......	......	78	84	160	96
Illinois	208	225	147	144	68	1,040	530	624	560
Iowa	2,240	884	576	1,008	421	672	242	986	528
Kentucky	223	266	174	147	136	185	168	144	120
Maryland	1,001	1,077	231	121	301	1,014	789	1,100	960
Mississippi	416	416	504	1,186	638	1,216	655	1,784	1,184
Missouri	79	76	75	79	160	464	454	392	384
New Jersey	1,056	1,248	1,115	1,044	834	2,930	2,194	2,880	1,808
New Mexico	......	......	......	......	......	96	83	193	168
New York (Long Island)	......	......	......	......	......	2,912	2,191	3,960	2,352
North Carolina	260	396	126	160	78	185	234	168	264
South Carolina	1,656	1,656	744	2,240	1,236	1,180	3,079	3,089	3,176
Tennessee	172	180	192	218	201	184	320	801	672
Virginia (Norfolk, eastern shore)	3,504	3,714	1,620	1,780	1,287	1,318	2,953	2,880	1,800
Washington	121	127	120	150	208	837	589	684	568
Total	11,664	10,929	5,784	9,213	6,341	14,988	15,589	21,341	15,960
Late:									
Colorado	3,197	2,637	3,406	3,038	2,736	5,303	3,739	4,939	4,640
Indiana	520	308	988	918	418	972	523	748	1,040
Michigan	3,312	1,363	3,386	3,101	783	1,686	838	2,662	2,576
Minnesota	1,656	768	1,900	1,227	1,113	2,138	1,060	2,499	1,952
New York	28,720	7,690	16,527	20,384	10,462	24,682	11,905	17,924	13,608
Ohio	2,184	933	2,324	1,736	1,137	2,245	1,041	1,635	2,192
Oregon	126	152	125	154	242	505	589	504	360
Pennsylvania	520	222	196	198	205	2,394	1,306	1,571	1,104
Virginia (southwestern)	1,008	966	1,170	1,068	912	2,513	1,200	2,992	1,680
Wisconsin	10,692	4,637	7,741	7,360	5,104	12,110	5,059	14,586	10,136
Total	51,935	19,676	37,763	39,184	23,112	54,548	27,260	50,060	39,288
Grand total	69,727	37,589	48,267	54,731	35,406	86,344	53,920	87,819	61,768

* Data for the years 1915 to 1919, inclusive, are taken from the Yearbook of the United States Department of Agriculture for 1920, p. 671, 1921; for the years 1920 to 1922, inclusive, from the Yearbook for 1922, p. 763, 1923; for 1923, from *Weather, Crops, and Markets*, United States Department of Agriculture, vol. 4, p. 680, 1923, except the data for Long Island and Virginia (southwestern), which were obtained from the United States Bureau of Agricultural Economics.

The car-lot movements of all domestic fruits and vegetables in the United States for the six seasons from 1916–17 to 1921–22, inclusive, show that cabbage represents 4.48 per cent of the total. Its importance relative to other crops is shown in table 3:

TABLE 3. TOTAL CAR-LOT SHIPMENTS OF ALL DOMESTIC FRUITS AND VEGETABLES IN THE UNITED STATES, COMPARED BY PERCENTAGES*

Crop	Per cent
Potatoes (late crop)	24.28
Potatoes (early crop)	7.16
Apples	11.85
Citrus fruits	9.76
Watermelons	6.16
Grapes	4.89
Peaches	4.81
Cabbage	4.48
Cantaloupes	3.74
Onions	3.48
Sweet potatoes	2.09
Strawberries	2.00
Miscellaneous	15.30
Total	100.00

* From *Crops and Markets*, United States Department of Agriculture, vol. 1, suppl. 1, p. 36, 1924.

The car-lot shipments of cabbage by States of origin, for the years 1917 to 1923, are shown in table 4. New York ships almost twice as much cabbage as does any other State (figure 3). Wisconsin is next, and Texas South Carolina, and Virginia are about equal for third place.

TABLE 4. CAR-LOT SHIPMENTS OF CABBAGE BY STATES OF ORIGIN, 1917 to 1923*

State	Car lots†						
	1917	1918	1919	1920	1921	1922	1923
New York, Long Island	118	111	.....	36	.....	13	.....
New York, other	4,999	8,357	7,300‡	7,006	9,543‡	9,766	8,838‡
Pennsylvania	94	160	383	239	291	348	291
Maryland	171	63	254	260	325	448	220
Virginia	1,891	1,927	1,508	1,532	3,595	2,939	3,331
South Carolina	663	1,867	1,172	1,087	3,285	3,365	4,313
Florida	1,413	3,782	1,537	4,745	1,518	3,002	1,216
Ohio	546	578	283	342	335	590	497
Illinois	65	267	161	146	102	144	407
Michigan	524	430	385	335	472	871	614
Wisconsin	2,815	3,334	3,508	4,179	3,355	5,452	5,630
Minnesota	582	1,010	961	834	596	1,156	797
Iowa	453	389	205	374	144	560	351
Kentucky	96	121	185	128	98	73	106
Tennessee	51	117	175	141	176	563	274
Alabama	87	860	421	265	940	1,366	1,561
Mississippi	281	1,128	566	884	577	1,629	1,134
Louisiana	150	258	188	233	313	349	448
Texas	931	304	1,437	4,828	1,757	3,996	1,364
Colorado	2,485	1,960	2,323	1,656	2,580	1,889	3,103
California	1,412	1,078	1,395	1,247	845	737	683
All other	527	560	635	523	871	809	890
Total	20,354	28,661	24,982	31,020	31,718	40,065	36,068

* United States Department of Agriculture, Yearbook for 1923, p. 752. 1924.
† Shipments as shown in car lots include those by boat, reduced to car-lot basis.
‡ Long Island included with "New York, other," in 1919, 1921, and 1923.

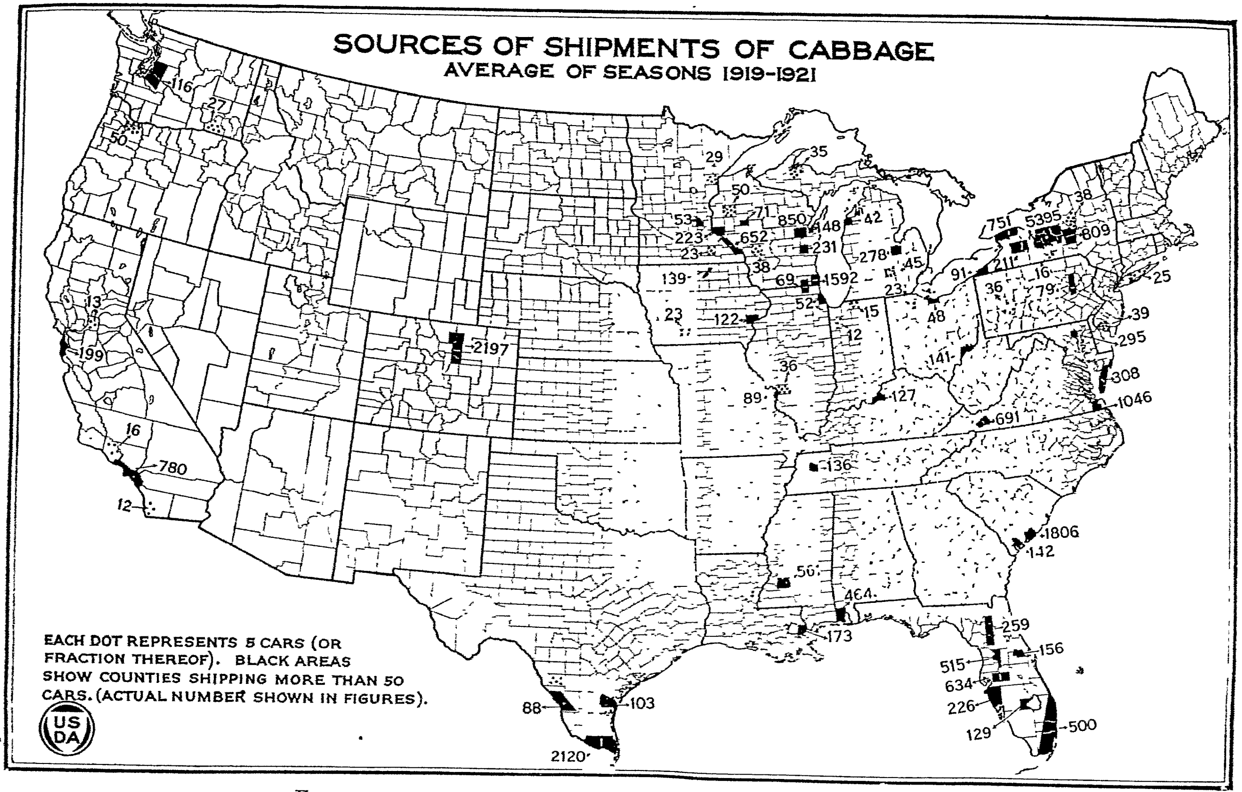


FIGURE 3. CABBAGE-PRODUCING AREAS IN THE UNITED STATES

The acreage, yield, and production of cabbage for sauerkraut are given in table 5, and the locations of the plants in New York are given in table 6. The largest amount of sauerkraut is manufactured at Phelps, Gorham, Ontario, Lyons, Fulton, and Canandaigua, and on Long Island.

TABLE 5. ACREAGE, YIELD, AND PRODUCTION OF CABBAGE GROWN FOR SAUERKRAUT, 1919 TO 1923*

State	1919	1920	1921	1922	1923
Acres:					
Colorado	20	100	70	220	240
Illinois	530	470	240	910	490
Indiana	390	360	..	630	1,120
Iowa	280	140	.....	500	360
Michigan	1,130	1,500	1,180	1,880	1,970
Minnesota	330	370	540	1,460	1,690
New York	2,360	2,410	1,980	4,420	5,000
Ohio	1,180	1,540	920	1,600	1,600
Washington	250	180	150	330	360
Wisconsin	1,030	980	1,670	3,500	3,680
Other States	300	270	290	520	660
Total	7,800	8,320	7,040	15,970	17,170
Yield per acre (tons):					
Colorado	11.4	14.2	11.7	12.0	15.3
Illinois	4.3	7.0	4.8	7.7	12.0
Indiana	6.0	7.0	.....	8.0	11.0
Iowa	4.3	7.7	.....	6.0	5.9
Michigan	5.7	8.0	10.0	12.0	10.5
Minnesota	6.2	4.9	7.0	10.0	7.4
New York	6.1	8.8	8.0	10.0	8.7
Ohio	5.6	7.5	8.3	11.0	9.3
Washington	11.2	11.3	8.0	14.5	8.0
Wisconsin	7.3	8.6	10.6	11.0	10.2
Other States	7.2	6.6	11.4	8.2	5.5
Total	6.1	8.1	9.0	10.3	9.3
Production (tons):					
Colorado	200	1,400	800	2,600	3,700
Illinois	2,300	3,300	1,200	7,000	5,900
Indiana	2,300	2,500	....	5,000	12,300
Iowa	1,200	1,100	....	3,000	2,100
Michigan	6,400	12,000	11,800	22,600	20,700
Minnesota	2,000	1,800	3,800	14,600	12,500
New York	14,400	21,200	15,800	44,200	43,500
Ohio	6,600	11,600	7,600	17,600	14,900
Washington	2,800	2,000	1,200	4,800	2,900
Wisconsin	7,500	8,400	17,700	38,500	37,500
Other States	2,200	1,800	3,300	4,300	3,600
Total	47,900	67,100	63,200	164,200	159,600

* From mimeographed sheet furnished by the United States Bureau of Agricultural Economics.

Inquiry has been made of the manufacturers of sauerkraut in the State as to the present practice followed by them in contracting for cabbage

CONTRACT

THIS AGREEMENT made this ....day of...................................19......
between the...of.................................New York
party of the first part, hereinafter described as the purchaser, and

....

of.., N. Y., party of the second part, hereinafter described as the seller,

WITNESSETH:—That the seller covenants and agrees to and with the purchaser to plant, cultivate and properly care for..............................acres of domestic cabbage, during the season of 19........, and to harvest, trim and deliver to the purchaser at either of its factories in the Village of.............................., N. Y., all the cabbage grown under this contract, when said cabbage shall have become ripe and in prime condition for market, said cabbage to be delivered properly trimmed, ripe and free from frost and rot. The field or fields in which the same is to be raised being on the farm occupied by the seller in the said town of.................................... and designated as follows:

....

....

....

The purchaser covenants and agrees to and with the seller to receive and accept from the seller the cabbage grown under this contract when delivered, in pursuance of the said terms thereof, and to pay seller therefor as follows: $................................ per ton for all cabbage delivered under this contract as aforesaid. Payment therefor to be made to the seller as follows: The one-half part thereof when said cabbage is delivered and the balance on or before January 25th following.

In the event that the seller herein is working the farm, now occupied by him, as a tenant on shares, the said seller hereby represents that he has the right to bind his landlord with reference to any interest that the said landlord may now or hereafter have in or to the subject matter of this contract. The seller herein hereby agrees not to chattel mortgage or otherwise encumber the cabbage crop to be raised under the terms of this contract without the written consent of the purchaser.

It is further agreed by and between the purchaser and seller herein that in case of strike, fire or other unavoidable accident preventing the purchaser from cutting and making said cabbage into kraut, this agreement may be rescinded at the option of the purchaser on giving written notice thereof to the seller.

This agreement is executed in duplicate; each party has one and both are originals for all purposes.

The covenants and agreements herein contained apply to and bind the heirs, executors, administrators, successors and assigns of the respective parties herein.

IN WITNESS WHEREOF, the parties hereto have hereunto set their hands and seals the day and year first above mentioned.

....

By..(L.S.)
Purchaser

By.. (L.S.)
Seller

FIGURE 4. FORM USED FOR CONTRACTING CABBAGE FOR THE MANUFACTURE OF SAUERKRAUT

(figure 4). The practice varies with different regions and firms, and in different years with the same firm. On Long Island, in general, none of the farmers make contracts. The reason for this is that in the seasons when the domestic crop is short on Long Island and in New Jersey, the crop can be disposed of to better advantage in the New York market. Up-state, of the nine firms reporting, two do not use contracts. Of the acreage of cabbage supplied to the remaining seven, less than half was grown under contract.

The contracting of cabbage does not appeal to the farmer, because the manufacturers will not agree to more than the usual price for a fairly large crop. This, in addition to placing upon the farmer the risk of having a poor crop because of climatic conditions, also takes away from him the opportunity of realizing the increase in price which accompanies unfavorable weather. The manufacturer then gets the benefit of the weather conditions. The tendency to contract for cabbage for sauerkraut is greater up-state than on Long Island, because the up-state grower of domestic cabbage has not so good an alternative market for his crop as have the Long Island farmers.

The contract is always advantageous to the manufacturer in years of a short cabbage crop, because the market price at the time of harvesting is more than the price at which cabbage is contracted for with the farmer. In years of a large crop, the advantage to the manufacturer of a contracted price is less. The farmer who grows domestic cabbage, however, has no seasonal opportunity with or without a contract. He must deliver the cabbage when the manufacturer calls for it or when it is ready to be used. He cannot hold it for seasonal changes in price, which for late cabbage depend not only on the size of the late crop but also on the size of the early crop in the South, because domestic cabbage cannot be stored.

TABLE 6. FIRMS ENGAGED IN 1923 IN THE MANUFACTURE OF SAUERKRAUT IN NEW YORK STATE, AND LOCATION OF THEIR PLANTS*

Firm	Address	Location of plant
Block & Guggenheimer, Inc.	327–329 E. 103d Street, New York	Pinelawn, Long Island; Bethpage, Long Island; South Bay, New York
Canandaigua Kraut Co.	Canandaigua	Canandaigua
Castle Co.	Lyons	Lyons
Demian Bros.	Huntington Sta., Long Island	Huntington, Long Island
Dick, Wm. C., Kraut Co.	434 Koons Avenue, Buffalo	Buffalo
Empire State Pickling Co.	Phelps	Phelps (2 plants), Gorham
Foreman, L. C., & Sons, Inc.	Pittsford	Pittsford, Palmyra
Golden Pickle Works	367–369 Park Avenue, Brooklyn	Greenlawn, Long Island; Deer Park, Long Island; Calverton, Long Island
Hemingway, H. C., & Co.	Syracuse	Lyons
Huxley, F. B., & Son	Ontario	Ontario

TABLE 6 (*concluded*)

Firm	Address	Location of plant
Karp, O., & Son, Inc.	205 E. 54th Street, New York	Oneida; Central Park, Long Island
Keller's, J., Sons	Farmingdale, Long Island	Farmingdale, Long Island
Lang's, Wm., Sons	1726–1728 Decatur Street, Brooklyn	Trumansburg, Woodburg, Evergreen
Moulton, Ward A.	Phoenix	Clay
New York Canners, Inc.	75 State Street, Rochester	Fulton, Canandaigua
Powell Corp.	Canandaigua	Canandaigua
Recht & Rosenbaum, Inc.	606 W. 49th Street, New York	Huntington, Long Island; Ontario
Seneca Kraut & Pickling Co.	Geneva	Phelps, Waterloo, Seneca Castle
Skaneateles Kraut Co.	Skaneateles	Skaneateles
Stern & Brauner, Inc.	511 W. 20th Street, New York	Farmingdale, Long Island
Webster Canning & Preserving Co.	Webster	Webster

* No firms engaged in the manufacture of kraut are intentionally omitted. This list was furnished by the secretary of the National Kraut Packers' Association, and the location of plants was obtained from the firms themselves. Libby, McNeil & Libby have a large plant at Hall, New York, but did not report.

SEASONAL MOVEMENT OF THE UNITED STATES CABBAGE CROP

The United States Bureau of Agricultural Economics maintains branch offices in the leading large cities which furnish the market for cabbage, and also in some cities in the shipping district, such as Rochester, New York, and Racine, Wisconsin. These branch offices issue daily market reports covering the car-lot arrivals, the cars on track, jobbing prices,

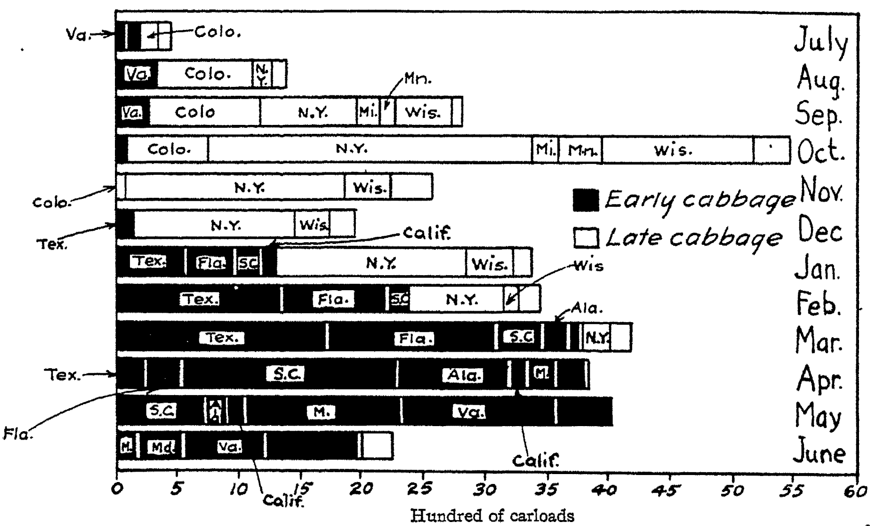


FIGURE 5. SEASONAL MOVEMENT OF CAR LOTS OF CABBAGE IN THE UNITED STATES, FROM JULY, 1921, TO JUNE, 1922

f. o. b. prices, cash prices to growers, and much other marketing information. This service is free to those who request it, and enables any one to maintain the daily contact with market changes so necessary to wise marketing.

The car-lot shipments of cabbage for two seasons, by months, from originating States, are shown in tables 7 and 8. The movement begins in Texas in December, and extends to Florida in January and February. In March occurs the largest movement of Texas and Florida cabbage of any of the months. The movement of the Alabama and South Carolina crops begins in March also, and reaches its peak in April. A large movement of the South Carolina crop extends into May, and in this month large shipments of the Virginia crop occur also. The Tennessee and Maryland crops move largely in June. July and August see very little car-lot movement of cabbage, as other fresh vegetables are being used then. In September and early October, the domestic crop in the northern States moves, and from October 15 till the following March is the season for the movement of the late Danish crop, chiefly from Wisconsin and New York. The movement of the crop from New York extends further into the winter than does that from Wisconsin, probably because New York has greater storage facilities, and because produce men there desire to ship late cabbage into Chicago, St. Louis, and other mid-western cities before the Florida crop is ready for New York. A very early southern crop or a large southern crop depresses the price for late cabbage.

COST OF PRODUCING CABBAGE

Cost accounts for the cabbage crop have been kept by from six to ten farmers in cooperation with the College for each year from 1914 to 1918, and the detailed results are reported in Bulletin 414 from this station.[3] In 1915 the cost per acre averaged the lowest, being \$51 per acre, or \$6.37 per ton; in 1918 the cost per acre was highest, being \$109 per acre, or \$14.76 per ton. The cost of harvesting and delivering a ton to the place of storing or shipping was lowest, \$1.46, in 1915, and highest, \$2.95, in 1918. The cost per ton depends more on yield than on costs per acre.

On 51 farms studied in the vicinity of Tully and Homer, an intensive dairy and cash-crop region, 11.5 per cent of the manure produced was applied to the cabbage crop at an average rate of 14.2 tons per acre. On these farms, corn received 42.5 per cent of the manure, new seedings 21.4 per cent, old meadows and alfalfa 14.9 per cent, potatoes 7.7 per cent, and other crops the small remainder. On the same farms, 166 acres of cabbage received an average application of 613 pounds of commercial fertilizer, and 75 acres of the 166 received in addition an average application of 2367 pounds of ground limestone per acre. The cash cost of this fertilizer was \$14.66 per acre. The kinds used most were acid phosphate, 2–8–3, and 2–8–10. The rate of application when acid phosphate was used averaged from 100 to 150 pounds more per acre than when the complete fertilizer was used.

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[3] Cost accounts for six years on some successful New York farms. By G. F. Warren and others. Cornell Univ. Agr. Exp. Sta., Bul. 414, p. 113–114. 1923.

TABLE 7. CAR-LOT SHIPMENTS OF CABBAGE DURING THE SEASON OF 1921–22, AS REPORTED TELEGRAPHICALLY TO THE UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS

	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	Total
Early crop:																		
Alabama, first crop				82	688	125	1											896
California, southern district, first crop				68	144	183	66	9	7									482
Florida	6	247	504	658	97	4												1,516
Georgia			3	4	22	21	8	1										59
Louisiana, first crop				45	177	66	2											290
Mississippi					268	301	8											577
North Carolina, first crop					48	161	8											217
South Carolina, first crop				540	2,103	268	1											2,912
Texas	21	220	353	753	300	13	6	4										1,670
Total	27	467	860	2,150	3,847	1,147	100	14	7									8,619
Intermediate crop:																		
California, northern district, first crop						19	5	1	6	5	5							41
Kansas							2	3										5
Kentucky							96	2										98
Maryland						20	305											325
Missouri							94	5										99
New Jersey							5	24										29
New Mexico, first crop							25	16										41
Oklahoma							4	3		1								8
Tennessee						30	146											176
Virginia, Norfolk, first crop					159	1,552	477											2,188
Virginia, eastern shore					12	417	209											638
West Virginia							15	6										21
Total					171	2,038	1,383	60	6	6	5							3,669
Late crop:																		
Alabama, second crop													1	23	29	57		110
California, northern district, second crop												1	1	25	16	23	12	78
California, southern district, second crop											2	63	40	130	70	48		353
Colorado								149	777	902	652	71	13					2,564
Connecticut											1							1
Idaho										1								1
Illinois							35	13	22	14	15	1						100
Indiana									4	12	3							19
Iowa							3	72	38	7	19	1						140
Louisiana, second crop													8	10	17	33		68
Maine								1	1		5	13	10	8	4	2		44
Massachusetts									1			5	3					9

Michigan	.....	.....	.....	.....	.....	.....	.....	.....	11	176	203	25	14	25	9	2	.....	465
Minnesota	.....	.....	.....	.....	.....	.....	1	12	30	135	349	34	7	14	.....	1	.....	583
Montana	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	3	1	2	.....	.....	.....	.....	7
Nebraska	.....	.....	.....	.....	.....	.....	.....	2	12	6	9	1	.....	.....	.....	.....	.....	30
New Hampshire	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	1	1	.....	1	.....	.....	5
New Mexico, second crop	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	4	.....	.....	.....	.....	.....	7
New York and Long Island	.....	.....	.....	.....	.....	.....	.....	.....	139	789	2,638	1,784	1,324	1,550	766	256	22	9,268
North Carolina, second crop	.....	.....	.....	.....	.....	.....	.....	.....	1	4	5	1	2	.....	.....	.....	.....	13
North Dakota	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	2
Ohio	.....	.....	.....	.....	.....	.....	178	36	7	37	63	13	.....	.....	1	.....	.....	335
Oregon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	38	3	.....	.....	.....	47
Pennsylvania	.....	.....	.....	.....	.....	.....	1	7	.....	16	169	71	14	18	5	2	.....	303
South Carolina, second crop	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	32	184	162	115	.....	494
South Dakota	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	2
Utah	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	2	4	.....	.....	.....	.....	8
Vermont	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	2	3	.....	.....	.....	.....	.....	6
Virginia, Norfolk, second crop	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	4	7	1	.....	.....	13
Virginia, Roanoke section	.....	.....	.....	.....	.....	.....	.....	85	315	267	93	.....	.....	.....	.....	.....	.....	760
Washington	.....	.....	.....	.....	.....	.....	26	8	3	5	23	81	20	4	.....	.....	.....	170
Wisconsin	.....	.....	.....	.....	.....	.....	.....	.....	17	440	1,201	373	282	360	135	12	.....	2,820
Total	.....	.....	.....	.....	.....	.....	244	385	1,380	2,812	5,462	2,558	1,820	2,361	1,216	553	34	18,825

TABLE 8. CAR-LOT SHIPMENTS OF CABBAGE DURING THE SEASON OF 1922–23, AS REPORTED TELEGRAPHICALLY TO THE UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS

	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	Total
Early crop:																			
Alabama, first crop					194	884	171	5											1,254
California, southern district, first crop					44	132	137	40											353
Florida		8	415	853	1,376	303	36												2,991
Georgia				7	23	51	47	22					1						151
Louisiana, first crop					43	181	45	5											274
Mississippi					2	229	1,265	133											1,629
North Carolina, first crop						15	130	4	4	1									154
South Carolina, first crop					242	1,752	743	4											2,741
Texas	2	106	568	1,346	1,708	249	30	18	15	1									4,043
Total	2	114	983	2,206	3,632	3,796	2,604	231	19	2			1						13,590
Intermediate crop:																			
Arkansas							2	6											8
California, northern district, first crop							5	29											34
Kansas									11			1							12
Kentucky								66	6				1						73
Maryland							12	426	10										448
Missouri								11	5										16
New Jersey								58	8	1	1								68
New Mexico, first crop								32	13										45
Oklahoma								7	2										9
Tennessee							128	429	6										563
Virginia, Norfolk, first crop						1	963	305											1,269
Virginia, eastern shore							292	348											640
West Virginia								16	13										29
Total						1	1,402	1,733	74	1	1	1	1						3,214
Late crop:																			
Alabama, second crop														3	61	59	83		206
Arizona													1				5		6
California, northern district, second crop											10	8	1	4	5	34	69	10	141
California, southern district, second crop														3	18	35	66		122
Colorado								2	89	309	557	693	166	73	54	15	6		1,964
Idaho											1	1				2	3		7
Illinois								12	19	41	23	46	3						144
Indiana										12	13	8	1						34
Iowa									158	246	73	51	23	9	3	2	1		566
Louisiana, second crop													2	13	27	53	56		151
Maine												7	4	1	1	2			15
Massachusetts												1					1		2
Michigan									1	84	272	340	109	29	47	18	8		908
Minnesota								2	31	62	289	562	154	41	35	14	2		1,192
Montana												5	3		2	1	6		17

Nebraska									14		3	12	3	1		1			34
New Mexico, second crop												4	4	3	4				15
New York and Long Island									1	108	838	2,511	2,224	1,499	1,393	1,084	580	25	10,263
North Carolina, second crop											21	26	12		3	3	3		68
North Dakota												1				1	1		3
Ohio								243	90	11	49	151	45						589
Oregon													1						1
Pennsylvania								1		1	31	194	77	19	34	29	20		406
South Carolina, second crop													11	152	262	118	56		599
South Dakota											1		1						2
Utah											5	10	10	3	1	1	13		43
Vermont												1	2	1					4
Virginia, Norfolk, second crop														12	14	2			28
Virginia, Roanoke section									152	360	330	137	30	1					1,010
Washington								28	11		4	25	17	10	2	4	2	1	104
Wisconsin									1	199	1,002	2,264	886	593	658	213	59		5,875
Wyoming												1					3		4
Total								288	567	1,433	3,522	7,059	3,790	2,470	2,624	1,691	1,043	36	24,523

FREIGHT RATES

The freight rates on cabbage from Cortland, New York, to New York City, from 1913 to 1923, are shown in table 9. Considering the freight rate for 1913 as 100, the rate in the fall of 1915 was 5 per cent higher than the 1913 rate; in the fall of 1917, 20 per cent higher; in the fall of 1918, 50 per cent higher; and in the fall of 1920, 110 per cent higher. In other words, from 1913 to 1920 the freight rates more than doubled. The first decrease came on July 1, 1922, when the rate was cut 10 per cent, but in 1923 the rate was 90 per cent higher than the average for 1913.

TABLE 9. FREIGHT RATES ON CABBAGE FROM CORTLAND, NEW YORK, TO NEW YORK CITY*

	Rate per ton	Index number
Average for 1913	$3.00	100.0
January 1, 1900	3.00	100.0
October 15, 1915	3.16	105.3
August 1, 1917	3.20	106.7
August 9, 1917	3.60	120.0
June 25, 1918	4.50	150.0
August 26, 1920	6.30	210.0
July 1, 1922	5.70	190.0
January 1, 1923	5.70	190.0

* U. S. Agr. Dept. Yearbook 1922, p. 1018. 1923.

Cabbage takes the fifth-class rate for both intra- and interstate shipments. There are no commodity tariffs applied to it. The rate in January, 1924, from Cortland or from Rochester to either Philadelphia or New York, was 28.5 cents per 100 pounds, when shipped in bulk, barrel,

TABLE 10. FREIGHT RATES AND REFRIGERATION CHARGES ON CABBAGE FROM ROCHESTER AND CORTLAND TO VARIOUS CITIES ON AUGUST 26, 1924

Destination	Freight rate, in cents per 100 pounds	Refrigeration charge, in dollars per car	
	From Rochester and Cortland	From Rochester	From Cortland
Boston, Massachusetts	33.5	$55	$50
New York, New York	28.5	50	45
Baltimore, Maryland	28.5	60	60
Washington, D. C.	33.5	60	60
Philadelphia, Pennsylvania	28.5	55	50
Pittsburgh, Pennsylvania	27.0	50	55
Knoxville, Tennessee	68.0	75	75
Cleveland, Ohio	27.0	50	55
St. Louis, Missouri	46.0	60	65
Chicago, Illinois	39.5	60	65

or crate, subject to a minimum of 24,000 pounds, including the weight of containers and bulkheads. The freight, therefore, from each of the districts where late cabbage is extensively grown in New York is the same to the leading markets.

The freight rates and refrigeration charges on cabbage for August 26, 1924, from Cortland and Rochester to various cities are given in table 10.

The rates for December, 1923, on cabbage from southern points to New York City, are as shown in table 11:

TABLE 11. FREIGHT RATES ON CABBAGE FROM SOUTHERN POINTS TO NEW YORK CITY, DECEMBER, 1923*

Shipping place	All rail	Rail and water
	In bulk or crates (rate per ton)	In packages only
Leesburg, Florida	$23.50	$0.99 (standard barrel or barrel crate)†
Charleston, South Carolina	13.80	
Meggett, South Carolina	15.00	
Roanoke, Virginia	9 50	$0.475‡
Norfolk, Virginia	6.20§ 8.10‖	

* Furnished by J. A. Cross, specialist in transportation, United States Bureau of Agricultural Economics.
† Via Jacksonville and Clyde Steamship Co., or Savannah and Ocean Steamship Co.
‡ Via Norfolk and Ohio Domestic Transfer Co.
§ In bulk.
‖ In packages per standard barrel or barrel crate, 40.5 cents.

The all-rail rates from Norfolk, Virginia, in packages, are 40.5 cents per standard barrel or barrel crate, any quantity, and 49 cents per single barrel, any quantity.

The changes in the freight charges since 1909 are shown in table 12:

TABLE 12. FREIGHT RATES ON CABBAGE FROM SOUTHERN POINTS TO NEW YORK CITY SINCE 1909

Year of change in rate	Freight per ton, all-rail rate		
	From Leesburg, Florida	From Charleston, South Carolina	From Roanoke, Virginia
1909	....	....	$ 5.60
1910	$15.70	$ 9.20	....
1915	....	....	5.88
1917	....	....	6.80
1918	19.60	11.50	8.50
1920	26.10	15.30	7.50
1920	....	....	10.50
1922	23.50	13.80	9.50
1922	23.20	....	....

The refrigeration charges in 1924 to New York City were $70 per car from Leesburg, Florida, and Meggett, South Carolina, and $52.50 per car from Roanoke, Virginia, and Norfolk, Virginia.

The freight rates on cabbage from Florida to New York City in 1924 were 148 per cent of the 1913 rate, from South Carolina 150 per cent, from Virginia 170 per cent, and from Cortland, New York, 190 per cent. The index numbers of prices cannot be compared with the freight rates because of the extreme variability of prices, due to the effects of weather conditions on the size of the crop.

The protective measures necessary to insure against damage from frost or freezing need not be so rigid for cabbage as for potatoes. In winter weather, straw is usually placed over the false floors in the refrigerator car, and the car is lined sometimes with building paper. Heat is used while the car is being loaded, but is almost never sent in the car while in transit.

In the warm weather of early fall or spring it is equally important to protect the cabbage from heat. Warm cabbage placed in a warm car may become slimy. In extremely warm weather the shipper should call for cars initially iced. The car is then cooled before loading. The practice of initially icing cars varies with the icing facilities. As a rule, when refrigeration charges are quoted on a car-lot basis, if necessary the cars will be initially iced without further charge. Refrigeration here means the placing of ice in the bunkers of the cars, and not the so-called "top-dressing" used for highly perishable produce, for which there are other provisions in the tariff.

CABBAGE PRODUCTION IN NEW YORK

ACREAGE

The United States census reports do not include the acreage of cabbage by counties. This has been obtained from the United States Bureau of the Census, and appears in table 13. In 1919, according to these data, New York harvested 30,555 acres of cabbage raised for sale. The largest

TABLE 13. ACRES OF CABBAGE RAISED FOR SALE, HARVESTED IN 1919*

County	Acres harvested	County	Acres harvested
Albany	514	Essex	28
Allegany	22	Franklin	18
Bronx	1	Fulton	51
Broome	138	Genesee	591
Cattaraugus	194	Greene	29
Cayuga	1,154	Hamilton	1
Chautauqua	94	Herkimer	97
Chemung	81	Jefferson	59
Chenango	604	Kings	46
Clinton	54	Lewis	33
Columbia	55	Livingston	593
Cortland	1,428	Madison	585
Delaware	65	Monroe	3,154
Dutchess	115	Montgomery	106
Erie	614	Nassau	2,013

* Furnished by the United States Bureau of the Census.

TABLE 13 (*concluded*)

County	Acres harvested	County	Acres harvested
New York	25	Schoharie	20
Niagara	1,026	Schuyler	6
Oneida	377	Seneca	416
Onondaga	3,288	Steuben	70
Ontario	4,974	Suffolk	1,428
Orange	117	Sullivan	20
Orleans	1,316	Tioga	45
Oswego	109	Tompkins	311
Otsego	106	Ulster	145
Putnam	4	Warren	36
Queens	736	Washington	32
Rensselaer	150	Wayne	1,962
Richmond	92	Westchester	77
Rockland	108	Wyoming	51
St. Lawrence	120	Yates	628
Saratoga	119		
Schenectady	104	State total	30,555

acreages were harvested in the following counties: Ontario, 4974; Onondaga, 3288; Monroe, 3154; Nassau, 2013; Wayne, 1962; Cortland, 1428; Suffolk, 1428; Orleans, 1316; Cayuga, 1154; Niagara, 1026. This includes all of the counties harvesting 1000 or more acres of cabbage for sale in 1919. The distribution of the acreage of the State is shown in figure 6.

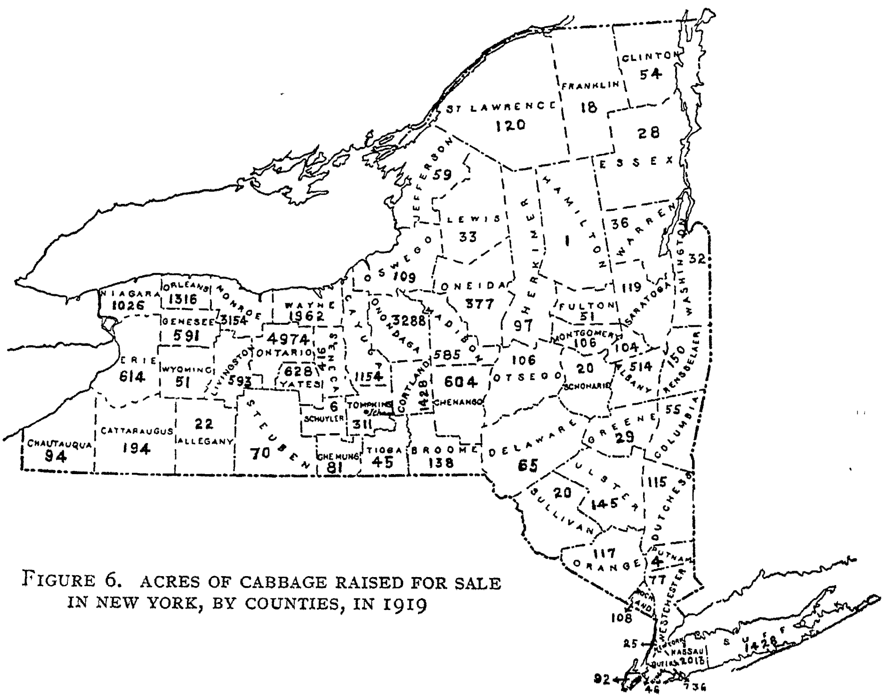


FIGURE 6. ACRES OF CABBAGE RAISED FOR SALE IN NEW YORK, BY COUNTIES, IN 1919

In the same year there were grown in New York the following acreages of various other green-vegetable crops: green peas, 17,440 acres; green beans, 6628; cucumbers, 4840; lettuce, 3392; celery, 3288. It will be noticed from this that New York grows nearly as many acres of cabbage as of all these five crops combined.

The acreage of cabbage in New York has not varied widely for the four years since the general decline in prices of farm products began. Before that decline, the variation was greater. In some sections, this crop has become a more settled enterprise than it was a few years ago. The variation in acreage is always less in regions where cabbage is grown as a cash crop on dairy farms than it is in western New York.

There has been more variation in the yield per acre than in the acreage planted to the crop. This suggests that the price received by the producer for his crop depends more on weather conditions, disease, and other factors influencing yield, than on the acreage planted. After a year of high prices there is a tendency to increase the acreage, and after about two years of low prices the acreage is slightly reduced.

The yield per acre has ranged from 5.4 tons in 1916 to 11.6 tons for late cabbage in 1920 (table 14). The combination of a low acreage and a low yield per acre in 1916, 1919, and 1921, resulted in especially high prices in those years.

TABLE 14. VARIATION IN ACREAGE HARVESTED, AND IN YIELD PER ACRE, OF ALL CABBAGE INCLUDING KRAUT IN NEW YORK*

Year	New York		Long Island	
	Acreage	Yield per acre (tons)	Acreage	Yield per acre (tons)
1915 †	35,900	10.0	....	....
1916 †	17,800	5.4	....	....
1917 †	28,300	7.3	....	....
1918 †	28,000	9.1	....	....
1919 †	20,120	6.5	....	....
1920	26,597	11.6	4,550	8.0
1921	22,895	6.5	4,150	6.6
1922	24,895	9.0	4,500	11.0
1923	22,680	7.5	4,200	7.0
1924	23,380	11.4	4,200	9.4

* Data for the years 1915 to 1919, inclusive, are taken from the Yearbook of the United States Department of Agriculture for 1920, p. 671, 1921; for the years 1920 to 1922, inclusive, from the Yearbook for 1922, p. 763, 1923; for 1923, from *Weather, Crops, and Markets*, United States Department of Agriculture, vol. 4, p. 680, 1923; for 1924, from *Crops and Markets*, United States Department of Agriculture, vol. 1, suppl. 12, p. 416, 1924. Data for Long Island for the years from 1920 to 1922 are from the United States Bureau of Agricultural Economics.
† Long Island included.

The acreage for the State, as reported by the Division of Livestock and Crop Estimates, was about two-thirds of the acreage reported by the Census. It is probably not quite correct to assume that this proportion holds for each of the other years, as there was more than the normal abandonment of acreage in 1919, the year of the census.

According to the United States Bureau of the Census, the acreage of cabbage raised for sale in each county of Wisconsin, the second largest cabbage-producing State, was as shown in table 15:

TABLE 15. ACREAGE OF CABBAGE RAISED FOR SALE, HARVESTED IN WISCONSIN IN 1919 (BY COUNTIES)

County	Acreage harvested	County	Acreage harvested	County	Acreage harvested
Adams	7	Iowa	1	Portage	13
Ashland	11	Iron	2	Price	15
Barron	124	Jackson	17	Racine	2,476
Bayfield	9	Jefferson	4	Richland	1
Brown	431	Juneau	3	Rock	83
Buffalo	3	Kenosha	1,878	Rusk	6
Burnett	4	Kewaunee	23	St. Croix	389
Calumet	28	La Crosse	63	Sauk	4
Chippewa	237	Lafayette	7	Sawyer	9
Clark	222	Langlade	5	Shawano	49
Columbia	163	Lincoln	15	Sheboygan	30
Crawford	19	Manitowoc	48	Taylor	2
Dane	99	Marathon	11	Trempealeau	5
Dodge	98	Marinette	32	Vernon	13
Door	3	Marquette	7	Vilas	3
Douglas	13	Milwaukee	998	Walworth	130
Dunn	2	Monroe	196	Washburn	6
Eau Claire	521	Oconto	8	Washington	15
Florence	3	Oneida	5	Waukesha	64
Fond du Lac	282	Outagamie	2,314	Waupaca	81
Forest	7	Ozaukee	17	Waushara	3
Grant	22	Pepin	50	Winnebago	61
Green	1	Pierce	334	Wood	114
Green Lake	4	Polk	32	....	......
				State, total	11,955

CAR-LOT SHIPMENTS

The total production of the cabbage crop varies greatly with the favorableness of the season. The crop requires plenty of moisture for its maximum yield, and in a dry season the upland fields, especially in the western part of the State where the rainfall is normally less and where less manure is used than in the central part, suffer. In central New York areas, the low valley soils, the large supply of manure where cabbage is grown on dairy farms, and the normally heavy rainfall, make a fair yield practically certain.

Another index of the geography of cabbage production in New York is the car-lot shipments as reported by the United States Department of Agriculture (figure 7). The shipping points by counties, and the carloads shipped from each station for four calendar years, are given in table 16 and are summarized in table 17. In 1922 the following 26 stations loaded more than 100 carloads of cabbage each: Moravia, Sherburne, Cortland, Homer,

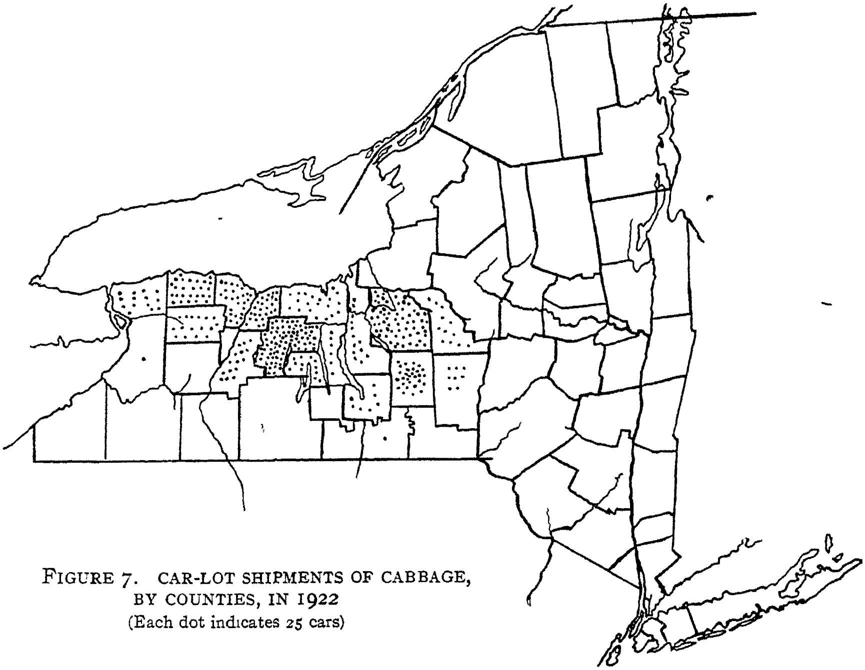


FIGURE 7. CAR-LOT SHIPMENTS OF CABBAGE, BY COUNTIES, IN 1922
(Each dot indicates 25 cars)

Preble, Batavia, Churchville, Fairport, Hamlin, Spencerport, Apulia, Marcellus, Martisco, Skaneateles, Tully, Aloquin, Geneva, Gorham, Hall, Phelps Junction, Seneca Castle, Stanley, Brice, Kendall, Newark, and Bellona.

TABLE 16. SHIPPING POINTS OF NEW YORK CABBAGE AND CARLOADS SHIPPED, FOR FOUR CALENDAR YEARS

Shipping point	Number of carloads			
	1921	1922	1923	1924
Albany County:				
Albany	..	..	2	..
Glenmont	3	1	3	1
Selkirk	..	..	2	..
Wemple	3	..	2	..
West Albany	2	..	..	..
Allegany County:				
Alfred	1	..	..	..
Almond	1	.	..	..
Angelica	..	2	..	..
Broome County:				
Binghamton	2	..	..	..
Conklin	2	..	..	..
Deposit	1	..	..	..
Harpursville	..	..	..	1
Killawog	..	3	3	2
Lisle	..	..	1	..
Nineveh	11	9	16	20
Whitney Point	3	1	4	5
Cayuga County:				
Auburn	83	33	19	30
Aurora	..	..	43	..
Cato	77	27	..	49
Cayuga	..	1	..	..
Crocketts	4	1	1	3
Ensenore	2	..	1	..
Fair Haven	3	..	..	2
Cayuga County (*concluded*):				
Genoa	34	28	12	..
Ira	9	3	6	4
King Ferry	1	..	..	..
Locke	54	24	48	62
Mapleton	..	15	4	..
Martville	1	..	..	..
Merrifield	37	6	..	..
Montezuma	2	..	..	..
Moravia	234	112	123	207
North Port Byron	4	2	1	1
Oakwood	..	1	4	2
Owasco Lake	8	21	4	11
Port Byron	2	1	2	1
Sennett	68	27	17	12
Sterling Station	..	..	1	2
Union Springs	..	..	1	1
Venice Center	6	1	1	..
Weedsport	48	29	18	33
Chautauqua County:				
Cherry Creek	1	..	..	1
Clymer Station	4	7	..	1
Dewittville	1	3	..	..
Frewsburg	6	..	1	..
Gerry	..	1	..	..
Jamestown	1	..	..	..
Sheridan	..	1	..	..

TABLE 16 (*continued*)

Shipping point	Number of carloads 1921	1922	1923	1924
Chautauqua County (*concluded*):				
Sinclairville	1	6	.	.
Chemung County:				
Big Flats	22	13	3	9
Elmira	10	1	1	1
Chenango County:				
Afton	62	25	47	49
Bainbridge	42	11	34	7
Coventry		2		3
Galena	49	3	40	17
Greene	6	2	5	5
Mount Upton		.		2
New Berlin	25	2	11	6
Norwich	15	5	18	4
Oxford		..	3	5
Sherburne	194	112	229	173
Sherburne Four Corners	24	14	30	30
Smyrna	61	36	43	25
South New Berlin	.		5	2
Columbia County:				
Craryville	2	2	..	..
Cortland County:				
Blodgett Mills	18	6	18	11
Cincinnatus	4	.	3	5
Cortland	173	131	194	166
Cuyler	6	10	6	..
East Freetown	12	7	7	10
East Homer	31	7	38	25
Homer	230	260	302	301
Little York	102	56	108	100
McGraw	66	29	63	42
Marathon	101	8	65	13
Messengerville	11	1	19	6
Mills	2	1	3	2
North Harford	17	7	17	9
Preble	86	203	182	172
Truxton	40	24	37	31
Delaware County:				
Hamden	..	.	1	.
Sidney	10	2	7	..
Erie County:				
Akron	..	3	1	1
Akron Falls	5	2	..	.
Alden	..	7	..	.
Clarence	3	..	..	.
Clarence Center	..	2	1	..
Crittenden	12	9	9	7
Getzville	7		..	.
Glenwood	2	1		..
Orchard Park	.	1		1
Wende	6	.		.
Essex County:				
Willsboro	2	.	.	.
Franklin County:				
Moira	1	..	..	..
Genesee County:				
Alabama	4	8	11	12
Alexander	..	1	2	.
Batavia	53	132	37	97
Bergen	1	..	1	.
Byron	4	16	3	3
Corfu	21	24	16	19
Darien Center	3	..	..	..
D., L. & W. Junction	2	4	1	..
East Bergen	3	5	2	3
East Bethany	9	24	8	5
East Pembroke	23	24	26	2
Elba	14	15	7	3
Fargo	11	32	9	6
Le Roy	8	29	13	9
North Alexander	4	6	2	3
North Darien	..	1	3	..
North Le Roy	.	1	..	..
Oakfield	49	57	33	55
Pavilion	5	6	3	3
Pembroke	6	3	7	5

Shipping point	Number of carloads 1921	1922	1923	1924
Genesee County (*concluded*):				
South Byron	..	.	2	..
Stafford	3	10	3	13
West Bergen	..	2	..	..
Wheatville	.	5	3	2
Herkimer County:				
Frankfort Station	1	.	..	..
West Winfield	1	1	1	..
Livingston County:				
Avon	7	13	2	2
Caledonia	2	14	1	5
Conesus	1	3	2	.
Craigs	10	7	2	5
Geneseo	1	.	..	..
Greigsville	3	.	..	..
Hemlock	4	10	7	12
Inverness	.	11	3	5
Lakeville	10	16	3	10
Lima	41	64	23	52
Linwood	31	59	29	49
Livonia	46	46	34	59
Livonia Station	20	53	26	41
Mount Morris	2	.	.	
Retsof	.	.	1	.
South Lima	9	34	12	34
South Livonia	55	32	39	18
Taylor		3	.	3
Webster	.	1	..	.
Woodruff	.	6	..	..
Madison County:				
Ballina	9	3	9	4
Bouckville	2	7	11	8
Cazenovia	2	..	3	4
De Ruyter	38	14	31	21
Earlville	38	11	49	38
Eaton	4	4	8	4
Erietown	5	8	6	2
Georgetown Station	3	..	1	.
Hamilton	64	71	84	91
Hubbardsville	55	61	87	51
Lebanon	12	2	18	2
Morrisville	21	9	20	16
New Woodstock	31	17	38	33
North Brookfield	..	1	4	2
Poolville	27	20	41	28
Pratts	2	.	2	3
Randallsville	55	53	78	85
Sheds Corner	25	16	12	15
Solsville	11	24	28	29
Monroe County:				
Adams Basin	20	66	34	53
Barnard	9	7	..	2
Brighton	..	1	.	..
Brockport	32	32	29	30
Charlotte	18	..	2	1
Chili	67	82	42	69
Chili Center	22	29	6	11
Churchville	49	122	55	109
Cold Water	3	2	1	..
Elmgrove	26	..	.	..
Fairport	106	126	106	116
Garbutt	.	4	2	..
Golah	8	5	1	..
Greece Station	6	7	1	8
Hamlin	66	105	67	105
Henrietta	39	37	38	51
Hilton	77	51	51	82
Honeoye Falls	68	92	26	76
Industry	12	10	2	2
Mendon	44	46	26	41
Mumford	31	27	1	13
Pittsford	69	82	38	70
Ridgeland	6	10	..	12
Rochester	7	6	3	6
Rochester Junction	22	16	7	17
Rush	24	17	23	30

TABLE 16 (*continued*)

Shipping point	Number of carloads 1921	1922	1923	1924
Monroe County (*concluded*):				
Scottsville	28	51	22	26
Spencerport	109	140	100	148
Union Hill	4	5	2	16
Uptonville	18	12	11	7
Wadsworth	9	15	2	5
Walker	25	45	55	50
Webster	53	48	33	45
West Henrietta	10	23	17	21
West Rush	5	3	2	2
Montgomery County:				
Amsterdam	20	1	8	3
Fonda	1	..	1	..
Nassau County:				
Hicksville	2	..	..	..
Niagara County:				
Appleton	27	44	56	81
Barker	86	88	103	120
Beach Ridge	2	..	..	..
Burt	44	35	19	52
Cambria	4	..	..	..
Elberta	1	10	8	8
Gasport	26	9	12	21
Lockport	43	23	6	15
Mapleton	..	4	..	..
Middleport	9	4	2	9
Newfane	14	36	32	68
Pendleton Center	10	1	2	..
Ransomville	16	21	24	36
Sanborn	7	3	..	..
Wilson Station	57	45	60	81
Wrights	20	32	29	48
Oneida County:				
Boonville	1	..	1	1
Bridgewater	4	..	2	..
Deansboro	4	5	4	..
Franklin Springs	1	..	..	..
Greenway	4	3	7	2
Oriskany Falls	1	3	6	3
Richfield Junction	1	..	1	..
Rome	2	..	..	1
Sauquoit	1	..	..	..
Utica	13	..	1	..
Waterville	7	1	9	4
Whitesboro	1	..	..	..
Onondaga County:				
Amboy	3	..	..	..
Apulia	158	171	156	187
Baldwinsville	172	94	171	160
Brewerton	1	2	..	..
Camillus	14	4	4	13
Clay	76	3	10	16
East Syracuse	2	1	..	..
Fairmount	1	3	..	1
Fayetteville	1	..	4	..
Half Way	63	33	27	63
Jamesville	7	8	16	7
Jordan	67	36	47	51
Kirkville	16	12	16	17
Lamson	22	12	47	27
Manlius	8	3	5	3
Marcellus	336	321	255	350
Martisco	80	217	..	14
Memphis	25	11	11	6
Minoa	2	..	..	..
Onativia	74	50	73	119
Oran	2	6	7	..
Skaneateles	265	186	94	59
Skaneateles Junction	78	86	18	58
Syracuse	1	..	3	..
Tully	290	292	288	415
Warner	14	11	5	11
Woodard	1	..	2	3
Ontario County:				
Aloquin	150	351	236	444
Canandaigua	19	38	17	41

Shipping point	Number of carloads 1921	1922	1923	1924
Ontario County (*concluded*)				
Chapin	4	1	5	12
Clifton Springs	56	53	94	93
Farmington	4	9	4	1
Fishers	3	11	9	1
Geneva	91	154	100	154
Gorham	2	137	47	217
Hall	255	161	224	235
Holcomb	65	61	45	57
Ionia	33	17	28	31
Manchester	10	20	5	..
Mertensia	5	11	7	6
Naples	1	1	..	..
Oaks Corners	28	23	33	43
Orleans	45	73	52	95
Phelps	44	31	64	57
Phelps Junction	64	147	142	271
Seneca Castle	487	493	634	785
Shortsville	3	4	1	1
Stanley	172	242	111	225
Victor	52	67	27	74
West Bloomfield	12	24	7	34
Orleans County:				
Albion	32	80	80	85
Ashwood	.	12	5	..
Brice	88	101	103	94
Carlton Station	24	61	67	66
Eagle Harbor Station	9	13	22	21
Fancher	10	40	26	51
Holley	11	20	33	31
Kendall	193	149	171	128
Knowlesville	4	5	1	4
Lyndonville	19	13	13	9
Medina	13	39	15	..
Millers	5	9	11	3
Morton	53	51	104	79
Waterport	47	47	55	28
Oswego County:				
Fulton	3	..	11	14
Lacona	..	..	..	1
Mexico	..	..	..	1
Oswego	2	..	..	..
Pennellville	4	..	..	..
Phoenix	9	..	6	2
South Granby	..	..	9	..
Otsego County:				
Milford	1	..	..	..
Richfield Springs	..	..	1	..
South Edmeston	3	2	..	2
Queens County:				
Queens	2	1	..	..
Rensselaer County:				
Brainard	..	..	7	2
Rensselaer	1	..	..	..
Saratoga County:				
Ballston Spa	8	..	6	..
Mechanicville	..	2	..	..
Schenectady County:				
Aqueduct	1	1	1	1
Schoharie County:				
Middleburg	3	..	..	..
Schoharie	1	5	1	2
Schuyler County:				
Beaver Dams	1	..	..	..
Reading Center	1	1	..	..
Watkins	7	4	2	2
Seneca County:				
Covert	..	..	2	..
Interlaken	..	1	4	3
Junius	90	65	71	133
Lodi Station	12	58	14	58
MacDougall	..	1	..	..
Romulus	..	5	..	8
Seneca Falls	..	1	..	13
Waterloo	20	8	5	14

TABLE 16 (*concluded*)

Shipping point	Number of carloads 1921	1922	1923	1924
Steuben County:				
Addison	2	..	1	1
Arkport	1	..	..	..
Campbell	1	..	..	..
Cohocton	..	..	..	1
Corning	2	..	..	..
Hammondsport	2	2	..	..
Hornell	1	..	..	..
Lindley	1	..	..	..
Painted Post	4	..	..	1
Suffolk County:				
Bridgehampton	..	..	..	2
Greenlawn	1	..	..	..
Huntington	1	..	..	..
Manorville	..	2	..	..
Northport	..	2	..	..
Port Jefferson	8	8	1	..
Shoreham	..	2	..	..
Tioga County:				
Owego	11	11	3	8
Smithboro	1	..	..	..
Spencer	10	5	9	1
Waverly	12	16	2	9
Willseyville	..	1	..	..
Tompkins County:				
Dryden	59	31	36	49
Etna	3	3	1	..
Freeville	3	1	5	1
Groton	56	50	60	74
McLean	42	68	64	73
North Lansing	..	2	..	..
South Lansing	7	2	..	..
Taughannock	..	..	5	1
Trumansburg	12	11	13	11
Ulster County:				
Hurley	1	1	1	1
Wayne County:				
Alton	8	1	1	5
Clyde	15	10	10	25
East Palmyra	15	32	16	14
East Williamson	..	..	2	2
Fruitland	15	10	6	8
Lyons	85	75	58	78
Macedon	2	1	3	1
Marion	28	39	30	32
Newark	80	113	54	148
Wayne County (*concluded*):				
North Macedon	10	14	8	5
North Newark	7	46	29	35
North Rose	13	5	8	1
Ontario	15	10	7	12
Palmyra	22	18	8	10
Port Gibson	37	53	66	106
Red Creek	68	34	39	18
Savannah	53	17	29	7
Sodus	..	..	..	3
Sodus Center	23	14	15	14
Sodus Point	22	21	29	17
South Palmyra	1	..	2	1
Wallington	1	..	5	..
Walworth	9	9	4	11
Wayneport	10	12	2	4
Williamson	10	1	1	3
Wolcott	23	22	25	24
Wyoming County:				
Attica	..	1	..	..
Bliss	20	7	17	5
Castile	1	..	..	..
Dale	..	..	1	..
Eagle	..	..	..	1
Gainesville	1	..	..	..
Hardys	3	..	2	..
Java Center	1	..	..	..
Pearl Creek	4	11	..	4
Perry	..	..	1	..
Silver Springs	1	..	..	..
Warsaw	1	..	1	..
Wyoming Station	2	..	1	..
Yates County:				
Barnes	..	1	..	..
Bellona	179	212	209	236
Benton	117	76	48	19
Dresden	3	4	1	..
Dundee	1	1	..	..
Earl	11	17	17	14
Himrod	3	4	1	..
Middlesex	..	..	1	1
Milo	1	8	..	..
Penn Yan	13	7	4	2
Rushville	43	2	44	43
Starkey	..	1	..	..

TABLE 17. SUMMARY OF CABBAGE SHIPMENTS, BY COUNTIES, FOR FOUR CALENDAR YEARS

County	Number of shipping points 1921	1922	1923	1924	Number of carloads shipped 1921	1922	1923	1924
Albany	3	1	4	1	8	1	9	1
Allegany	2	1	..	..	2	2	.....	.....
Broome	5	3	4	4	19	13	24	28
Cayuga	19	17	18	15	677	332	306	420
Chautauqua	6	5	1	2	14	18	1	2
Chemung	2	2	2	2	32	14	4	10
Chenango	9	10	11	13	478	212	465	328
Columbia	1	1	..	..	.....	2	.....	.....
Cortland	15	14	15	14	899	750	1,062	893
Delaware	1	1	2	..	10	2	8	.....
Erie	6	7	3	3	35	25	11	9

TABLE 17 (*concluded*)

County	Number of shipping points				Number of carloads shipped			
	1921	1922	1923	1924	1921	1922	1923	1924
Essex	1	.	..	..	2	. .	... ..	......
Franklin	1	..	..	..	1	. ....	......	......
Genesee	18	21	21	16	223	405	192	240
Herkimer	2	1	1	..	2	1	1	......
Livingston	15	16	14	13	242	372	184	295
Madison	18	16	19	18	404	321	530	436
Monroe	33	33	31	30	1,092	1,324	805	1,224
Montgomery	2	1	2	1	21	1	9	3
Nassau	1	..	..	..	2	. ...	......	......
Niagara	15	14	12	11	366	355	353	539
Oneida	12	4	8	5	40	12	31	11
Onondaga	27	22	21	20	1,779	1,562	1,259	1,580
Ontario	23	23	22	21	1,605	2,129	1,892	2,877
Orleans	13	14	14	12	508	640	706	599
Oswego	4	.	3	4	18	. . .	26	18
Otsego	2	1	1	1	4	2	1	2
Queens	1	1	..	.	2	1	......	......
Rensselaer	1	..	1	1	1	.. .	7	2
Saratoga	1	1	1	..	8	2	6	......
Schenectady	1	1	1	1	1	1	1	1
Schoharie	2	1	1	1	4	5	1	2
Schuyler	3	2	1	1	9	5	2	2
Seneca	3	7	5	6	122	139	96	229
Steuben	8	1	1	3	14	2	1	3
Suffolk	3	4	1	1	10	14	1	2
Tioga	4	4	3	3	34	33	14	18
Tompkins	7	8	7	6	182	168	184	209
Ulster	1	1	1	1	1	1	1	1
Wayne	24	22	25	25	572	557	457	584
Wyoming	9	3	6	3	34	19	23	10
Yates	9	11	8	6	371	333	325	315

Inquiry was made of the Pennsylvania Railroad station agent at Seneca Castle, New York, the heaviest shipping point in the State, as to the proportion of bulk cabbage moving to local and distant points during the period when domestic cabbage is marketed. He reported the shipments for the period from August 16 to October 31, 1923, inclusive, as follows:

To large cities.. 216 cars
(New York, Philadelphia, Baltimore, Washington, Pittsburgh, and others)
To near-by kraut factories.. 53 cars
(Canandaigua, Hall, Phelps, Ontario)
To distant kraut factories.. 64 cars
(Long Island and New Jersey points, a few Ohio points)
To points south of Richmond and Norfolk, Virginia (for domestic purposes).. 72 cars
Total cars reported to United States Bureau of Agricultural Economics during this period................................ 405 cars

From this it appears that 29 per cent of the car-lot shipments from Seneca Castle were destined to kraut factories. Information on this point for other stations in regions where kraut is made was not obtained, but it should be remembered that the car-lot movement of domestic cabbage for short distances to kraut factories must always be considered whenever cabbage shipments are studied.

RAINFALL IN THE NEW YORK CABBAGE DISTRICT

Relation of rainfall to yield

The nine stations given in table 18 cover most of the New York up-state commercial cabbage district. The data, taken from climatological reports, show the monthly normal rainfall at these stations for July, August, and September, and the total at each station.

TABLE 18. NORMAL RAINFALL FOR STATIONS IN THE NEW YORK CABBAGE DISTRICT

Station	Month						Average total of three-months rainfall (inches)
	July		August		September		
	Number of years entering into average	Average rainfall (inches)	Number of years entering into average	Average rainfall (inches)	Number of years entering into average	Average rainfall (inches)	
Syracuse	21	3.35	21	3.02	22	2.66	9.03
Cortland	30	4.25	30	3.76	30	3.33	11.34
Rochester	30	3.09	30	2.71	30	2.38	8.18
Skaneateles	28	3.90	29	3.73	30	3.64	11.27
Lockport	29	3.28	29	2.66	29	2.43	8.37
Penn Yan	15	3 40	16	2.68	16	2.33	8.41
Geneva	11	3 07	11	3.79	11	2.27	9.13
Avon	27	3 39	28	2.73	29	2.61	8.73
Lyons	14	3.73	14	3.21	14	2.42	9.36

The combined rainfall, by months, given in percentage of the normal for the stations included in table 18 that furnish records for each year of the thirty-one years from 1894 to 1924, and the seasonal departures of this combined rainfall from normal, are shown in table 19. These data show the variation of the rainfall during the three important cabbage-growing months, by years.

TABLE 19. ANNUAL JULY, AUGUST, AND SEPTEMBER RAINFALL IN THE NEW YORK CABBAGE DISTRICT FOR THE THIRTY-ONE YEARS FROM 1894 TO 1924, INCLUSIVE, IN RELATION TO NORMAL

Year	Per cent of normal				Departure above normal	Departure below normal
	July	August	September	Three-months total		
1894	74.9	40 8	155.1	92 5	......	7.5
1895	79 5	126.2	70 4	91 1	....	8.9
1896	140.8	91.7	144.4	125.7	25.7	....
1897	130.2	53.9	61.2	82.7	....	17.3
1898	63.3	183.4	127.0	121.2	21.2	......
1899	83.8	48.4	107.7	79.2	....	20.8

TABLE 19 (*concluded*)

Year	Per cent of normal				Departure above normal	Departure below normal
	July	August	September	Three-months total		
1900..........	119.2	76.9	64.1	89.3	....	10.7
1901..........	82.5	130.9	88.5	100.1	0.1	....
1902..........	194.4	73.6	80.3	120.0	20.0	....
1903..........	109.0	184.7	54.0	117.8	17.8	....
1904..........	140.7	88.1	139.0	122.9	22.9	....
1905..........	104.0	158.7	65.2	110.6	10.6	....
1906..........	107.2	116.9	84.1	103.6	3.6	....
1907..........	87.0	40.9	127.2	83.6	....	16.4
1908..........	123.0	57.6	44.2	78.3	....	21.7
1909..........	87.0	54.3	84.3	75.5	....	24.5
1910..........	91.8	92.9	159.4	112.4	12 4	....
191	89.2	104.9	108.5	100.1	0.1	....
1912..........	82.0	116.7	155.8	115.4	15.4	....
1913..........	53.4	86.6	73.8	70.6	....	29.4
1914..........	74.0	168.8	58.2	101.5	1.5	....
1915..........	144.0	162.0	148.3	151.4	51.4	....
1916..........	29.8	80.5	115.0	71.9	....	28.1
1917.........	113.8	95.2	98.2	102.4	2.4	....
1918..........	78.8	65.4	179.3	103.5	3.5	....
1919.........	108.4	103.5	49.8	89.7	....	10 3
1920.........	127.6	100.1	152.9	125.7	25.7	....
1921.........	109.1	75.4	74.5	87.7	....	12.3
1922.........	78.9	166.6	64.5	104.3	4.3	....
1923..........	78.7	38.6	100.8	71.3	....	28.7
1924..........	137.7	80.2	240.8	148.4	48.4	....

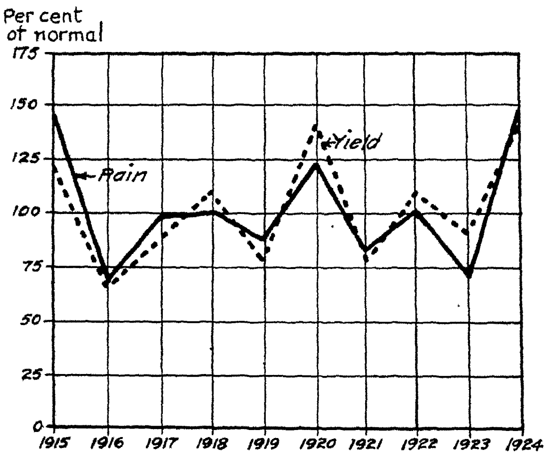


FIGURE 8. RELATION OF THE JULY, AUGUST, AND SEPTEMBER RAINFALL IN THE NEW YORK CABBAGE DISTRICT, TO THE YIELD PER ACRE OF CABBAGE IN THE STATE

The matter of how much rain falls is important, but that of how much of it is retained for crop use is even more so. A heavy rainfall may not be well distributed, resulting in much of it running off; or the season may be cool, with less than the normal amount of sunshine, in which case the loss thru evaporation is less than usual. The growing season of 1923 was cold as well as dry, so that evaporation was retarded.

The average yield per acre as reported by the Federal Government for

the nine years from 1915 to 1923, was 8.1 tons, but it varied from 5.4 to 11.6 tons (table 20). The percentage of the average yield was then determined for each year represented. These percentages are plotted in figure 8, and indicate the close relationship between the rainfall for these three months and the yield per acre. On the average, a variation of 10 per cent in the rainfall has resulted in a variation of 11 per cent in the yield per acre. Too little rain may result in no crop at all, but more than a required amount for maximum growth has no effect in increasing yield, and may even result in injury to a crop by drowning, by too little aeration of the soil, by interference with cultivation, and by stimulation of the growth of grass and weeds.

In 1915 the rainfall was considerably above normal in each of the three months indicated, as the data in table 20 show. In 1916 the July rainfall was only 30 per cent of normal, and the August rainfall 80 per

TABLE 20. RELATION OF JULY, AUGUST, AND SEPTEMBER RAINFALL IN THE CABBAGE DISTRICT, RELATIVE TO NORMAL, TO YIELD OF CABBAGE PER ACRE IN NEW YORK

Year	Per cent of normal precipitation	Actual yield per acre (tons)	Per cent of nine-years (1915-1923) average yield per acre
1915	151	10.0	123
1916	72	5.4	67
1917	102	7.3	90
1918	104	9.1	112
1919	90	6.5	80
1920	126	11.6	143
1921	88	6.5	80
1922	104	9.0	111
1923	71	7.5	93
1924	148	11.4	141

cent of normal. The dry July resulted in the loss of many plants already set, and to some extent accounts for the decided decrease in the forecast, as reported by the United States Department of Agriculture. The rainfall in September was 15 per cent above normal, but the July and August rainfall had been so low that the yield of cabbage per acre was the lowest that New York has had for the past nine years. In 1917 the rainfall was above normal in July, but below normal in August and in September. The average was 102 per cent of the normal precipitation in the cabbage district, and 90 per cent of the average yield per acre. In 1918, July was dry and August was very dry, but the rainfall in September was 79 per cent above normal. It was so heavy that the crop matured with greater weight than might have been expected from a rainfall such as that in July and August. The result was 104 per cent of the normal precipitation and 112 per cent of the average yield. In 1919 the rainfall in July and August was slightly above normal, but the September rainfall was only 50 per cent of normal, and the yield per acre for New York was 6.5 tons

per acre. The average precipitation for the three months was 90 per cent of normal, and the average yield per acre was 80 per cent of normal. The growing season of 1920 was wet, the average being 126 per cent of the normal precipitation. The yield per acre was the highest that has been reported for the past nine years, 11.6 tons, which was 143 per cent of normal. In 1921 the rainfall was 9 per cent above normal in July, but only three-fourths of normal in August and in September. As the season advanced, the rainfall diminished. The average rainfall for the three months was 88 per cent of normal, resulting in an 80-per-cent yield. In 1922, July and September were unusually dry, but August had the heaviest rainfall reported in the nine years. The resulting yield per acre was 11 per cent above normal, with a rainfall of 4 per cent above normal. In 1923, July was dry, August was by far the driest August for thirty years, and September was normal. The average was a 71-per-cent rainfall, and the yield per acre as reported was 93 per cent of the average. The largest difference between precipitation and yield per acre appears in 1923. While it is recognized that cabbage matured beyond expectations in the fall, due to the favorable conditions in the latter part of September and the first part of October, it may be possible that the final estimate of the yield was too high.

The weather stations in the vicinity of the largest cabbage-producing areas in Wisconsin are Milwaukee, Racine, New London, Green Bay, and Eau Claire. The United States Weather Bureau gives the mean total rainfall in July, August, and September at these five stations as 9.96 inches. At the nine New York stations given in table 18, it is 9.66 inches. The annual departures from normal rainfall at the stations in the Wisconsin cabbage district since 1915, as compared with those in the New York district, are given in table 21:

TABLE 21. COMPARISON OF ANNUAL DEPARTURES IN THE TOTAL JULY, AUGUST, AND SEPTEMBER RAINFALL, FROM NORMAL, IN WISCONSIN AND NEW YORK COMMERCIAL CABBAGE-PRODUCING AREAS

Year	Rainfall, in per cent of normal		Yield per acre in Wisconsin, in per cent of ten-years average
	New York	Wisconsin	
1915	151	117	117
1916	72	100	74
1917	102	78	96
1918	104	63	94
1919	90	115	85
1920	126	63	118
1921	88	118	71
1922	104	106	129
1923	71	100	112
1924	148	140	104

The yield per acre in Wisconsin does not show the close correlation to the weather at the stations mentioned above, that the New York yield per acre does to the rainfall in the New York commercial-cabbage district (tables 22 and 23). The reason for this, as is shown in figure 3,

Year	Condition				Yield of cabbage, in tons				
	September 1 (per cent)	September 1, truck-crop section† (per cent)	October 1 (per cent)	October 1, truck-crop section† (per cent)	As forecast on September 1, truck-crop section†	As forecast on October 1	As forecast on October 1, truck-crop section†	Final estimate now used: From yearbooks of U. S. Dept. Agr.‡	Final estimate now used: Truck-crop section
1911	74	....	77	....	....	7.8	....	....	....
1912	90	....	94	....	....	10.0	....	....	....
1913	68	....	60	....	....	5.5	....	....	....
1914	85	....	85	....	....	8.5	....	....	....
1915	95	....	89	....	....	8.5	....	10.0	....
1916	66	....	50	....	....	4.4	....	5.4	....
1917	88	....	85	....	....	8.1	....	7.3	....
1918	79	76	80	75	9.1	8.0	9.0	9.1	9.1
1919	73	65	....	39	7.8	5.8	4.7	6.5	6.5
1920	93	92	....	98	11.0	10.4	11.8	11.6	11.6
1921	68	58	....	60	7.0	5.9	7.2	6.5	6.5
1922	85	85	....	82	10.5	9.0	9.8	9.0	9.0
1923	65	70	....	70	8.4	6.7	8.4	7.5	7.5

* The data given in this table are taken from the following sources, all from the United States Department of Agriculture. For 1911: the *Crop Reporter*, vol. 13, p. 68 for September, p. 76 for October. For 1912: the *Crop Reporter*, vol. 14, p. 68 for September, p. 76 for October. For 1913: Farmers' Bulletin 558, p. 19, for September; Farmers' Bulletin 560, p. 14, for October. For 1914: Farmers' Bulletin 620, p. 31, for September; Farmers' Bulletin 629, p. 26, for October. For 1915: the *Monthly Crop Report*, vol. 1, p. 46 for September, p. 58 for October. For 1916: the *Monthly Crop Report*, vol. 2, p. 90 for September, p. 102 for October. For 1917: the *Monthly Crop Report*, vol. 3, p. 86 for September, p. 98 for October. For 1918: the *Monthly Crop Report*, vol. 4, p. 106 for September, p. 122 for October. For 1919: the *Monthly Crop Reporter*, vol. 5, p. 90 for September, p. 101 for October (yield per acre). For 1920: the *Monthly Crop Reporter*, vol. 6, p. 98 for September, p. 112 for October (yield per acre). For 1921: the *Monthly Crop Reporter*, vol. 7, p. 111 for September, p. 126 for October (yield per acre). For 1922: *Weather, Crops, and Markets*, vol. 2, p. 244 for September, p. 341 for October (yield per acre). For 1923: *Weather, Crops, and Markets*, vol. 4, p. 271 for September, p. 383 for October (yield per acre).

† Truck-crop section reports furnished by W. F. Callander, of the United States Bureau of Agricultural Economics.

‡ Data for 1915 are from the Yearbook of the United States Department of Agriculture for 1919, p. 671, 1920; those for 1920, 1921, and 1922 are from the Yearbook for 1922, p. 763, 1923; those for 1923 are from the Yearbook for 1923, p. 751, 1924.

TABLE 23. COMPARISON OF SEPTEMBER AND OCTOBER CONDITIONS AND OF YIELD OF CABBAGE PER ACRE IN WISCONSIN, AS FORECAST ON SEPTEMBER 1 AND ON OCTOBER 1, WITH THE FINAL REPORT ON YIELD AS NOW USED*

Year	Condition				Yield of cabbage, in tons			
	September 1 (per cent)	September 1, truck-crop section† (per cent)	October 1 (per cent)	October 1, truck-crop section† (per cent)	As forecast on September 1, truck-crop section†	As forecast on October 1, truck-crop section†	Final estimate now used: From yearbooks of U. S. Dept. Agr.‡	Final estimate now used: Truck-crop section
1911	81	......	90	......	......	......	......	......
1912	91	......	92	......	......	......	......	......
1913	89	......	84	......	......	......	......	......
1914	86	......	84	......	......	......	......	......
1915	95	......	110	......	......	......	9.9	......
1916	67	......	35	......	......	......	6.3	......
1917	90	......	100	......	......	......	8.2	......
1918	88	71	85	61	8.5	7.3	8.0	8.0
1919	78	70	......	65	8.4	7.8	7.2	7.2
1920	82	85	......	96	10.2	11.5	10.0	10.0
1921	62	55	......	55	6.6	6.6	6.0	6.0
1922	88	88	......	86	10.5	10.3	11.0	11.0
1923	80	82	......	77	10.0	9.2	9.5	9.5

* The data in this table are from the same sources as those in table 22, and are listed in the first footnote to that table.
† Truck-crop section reports furnished by W. F. Callander, of the United States Bureau of Agricultural Economics.
‡ Data for 1915 are from the Yearbook of the United States Department of Agriculture for 1919, p. 671, 1920, those for 1920, 1921, and 1922 are from the Yearbook for 1922, p. 763, 1923; those for 1923 are from the Yearbook for 1923, p. 751, 1924

s that the production of cabbage in Wisconsin is more scattered than in New York, and therefore it is more difficult to calculate an index of rainfall that will relate to the yield for the State as a whole.

Adverse conditions always decrease production, but if the strain is sufficiently resistant, or the care is such that the plants remain healthy, the amount of recuperation that can take place at the end of an unfavorable season if sufficient rain falls, is surprising. A greater recovery from setbacks is possible in regions of a long growing season, so that in this respect western New York has an advantage over the shorter-season regions of central New York. At the same time, it is much more subject to these setbacks than is central New York, because of the later setting, the lesser growing-season rainfall, and the warmer weather generally characteristic of lower elevations.

Lice, or aphids, sometimes limit the weight of cabbage. The effects of their ravaging are more serious in dry weather, if it is warm, especially in September. The high price that prevailed in years when September was very dry is shown later. It is possible that the amount of injury from lice late in the season was great in those years. Heavy, cold September rains, however, lessen their injurious effects. Grasshoppers and worms occasionally cause damage, such damage being greater on long narrow fields, where they work more along the edges. Woodchucks will soon completely destroy newly set plants by eating the heart, but after the plants are once started, the woodchucks feed on the outer leaves and thereby cause damage but not destruction. Woodchucks can be exterminated by putting carbon bisulfide on a piece of burlap, pushing the burlap far into the hole, and plugging the hole with dirt, or by using from one to two ounces of calcium cyanide in the hole.

Forecasting the production of cabbage in New York

Since when any product is scarce the price is high, and when it is plentiful the price is low, prediction of the probable scarcity or abundance of farm crops enables the producer to anticipate price conditions for the marketing season. This can be done fairly accurately for the cabbage crop from the rainfall data, in addition to the governmental forecast, because of the close correspondence between rainfall and yield.

The correlation between the variations in the combined July, August, and September rainfall in the up-state cabbage district of New York, and variations in the total tons of cabbage produced, is +0.94 without any adjustment for acreage. Since +1.00 would represent a perfect relationship, it is obvious that the production of cabbage can be very closely forecast from the July, August, and September rainfall (figure 9). For the nine years from 1915 to 1923, inclusive (figure 10), the following formula has predicted the total production of cabbage, within an average of 12 per cent of the final reports issued by the United States Department of Agriculture:

Reported acreage × average yield per acre × rainfall in per cent of normal = predicted production

The forecast production each year resulting from the use of this formula is compared with the final reported production in table 24 (page 40).

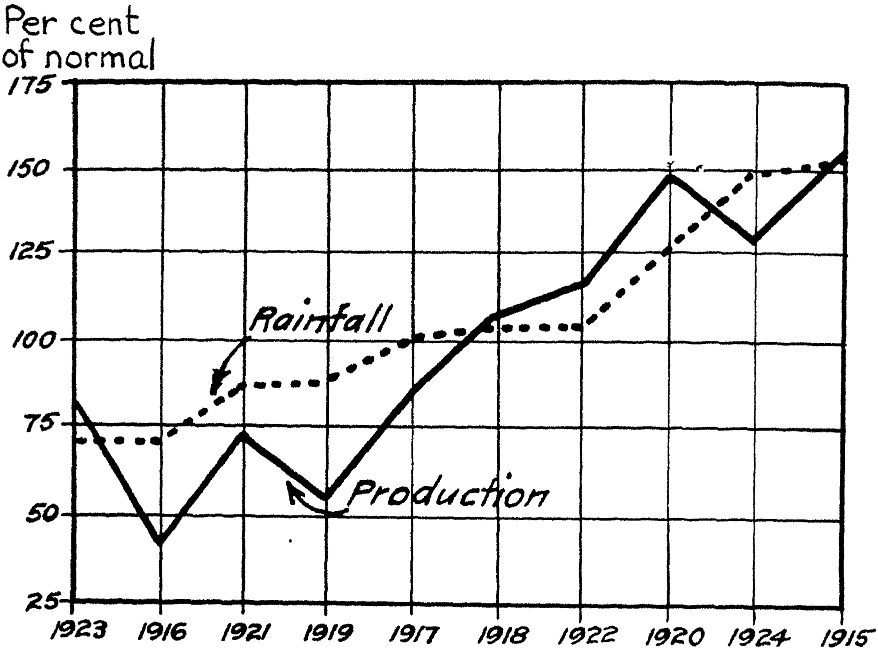


FIGURE 9. COMPARISON OF TONS OF CABBAGE PRODUCED IN NEW YORK STATE, WITH THE JULY, AUGUST, AND SEPTEMBER RAINFALL IN THE CABBAGE DISTRICT

The revised figures of the commercial-cabbage acreage show a decided alternating tendency in acreage set to cabbage.[4] These acreage figures do not check with the acreages originally reported in the yearbooks of the United States Department of Agriculture. They have been frequently revised. The data as they now stand show an average alternating change in acreage from the preceding year of 19 per cent for the years 1917 to 1924 inclusive.

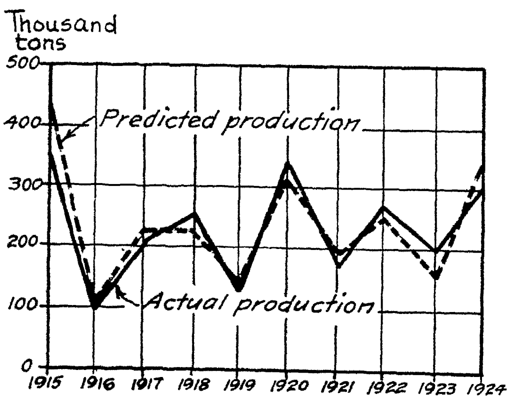


FIGURE 10. PRODUCTION OF THE CABBAGE CROP IN NEW YORK, INCLUDING LONG ISLAND, AS EXPECTED FROM RAINFALL AND ACREAGE, COMPARED WITH THE FINAL ESTIMATE OF PRODUCTION BY THE U. S. DEPARTMENT OF AGRICULTURE

The commercial-cabbage acreage reported for a given year includes the acreage harvested in Texas, Florida, the Carolinas, Virginia, and other early States, in January, February, March, April, and May, and the

[4] Scoville, G. P. Farm economics, no. 22, p. 250-251. March 21, 1925.

crop harvested from August to December in the intermediate and late States. Only the first part of the seasonal price for late cabbage affects the acreage of early cabbage in Florida, the Carolinas, and Virginia, but the acreage of early cabbage affects the seasonal price of late cabbage grown the preceding fall. Whether the Carolina and Virginia growers especially, pay much attention to the price for late cabbage when they plant their crop, is doubtful.

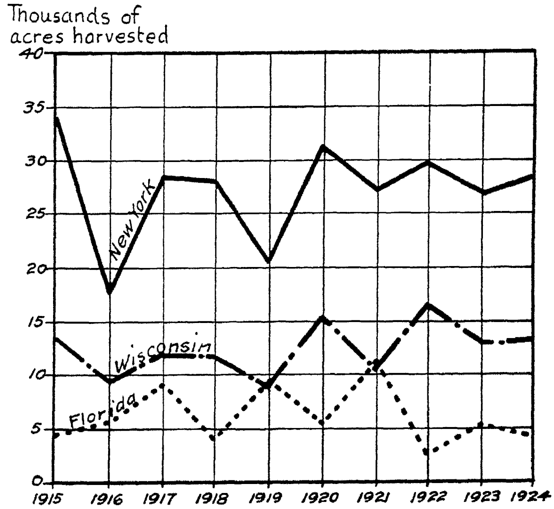


FIGURE 11. VARIATION IN THE COMMERCIAL-CABBAGE ACREAGE IN NEW YORK (INCLUDING LONG ISLAND), WISCONSIN, AND FLORIDA LAGGED ONE YEAR

In figure 11 it is seen that the acreage of cabbage harvested, as reported by the United States Department of Agriculture, has varied each year in the same direction for Wisconsin and New York, the two important surplus-late-cabbage-producing States. In figure 12 it is seen that the annual production of cabbage in these two States has varied in the same direction. This comparison between the two States is shown also in tables 22 and 23. Apparently the influences, chiefly prices, encouraging increased or decreased acreage, are the same in Wisconsin as in New York. As a result, usually but not always, when New York has a large crop, Wisconsin also has a large crop.

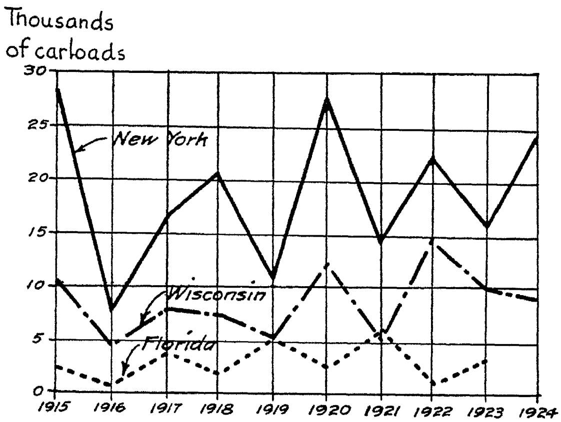


FIGURE 12. VARIATION IN THE PRODUCTION OF CABBAGE IN NEW YORK, WISCONSIN, AND FLORIDA LAGGED ONE YEAR

The acreage of cabbage harvested in Florida in 1922 competes with the Danish cabbage harvested in the preceding fall, or in 1921. Therefore, in figures 11 and 12 the acreage and production of Florida cabbage have been lagged one year, in order to study the facts for the same season. It may be seen that, beginning with 1917, both the acreage and the production in Florida were decreased

when New York and Wisconsin increased their acreage and production. Apparently Florida producers use reports concerning the acreage and production of the late cabbage crop in New York and Wisconsin as a guide for adjusting their own acreage. In this respect they have the advantage of the late-cabbage producers because of the opportunity to plant after the reports of the indicated production of late cabbage in the northern States have become available.

The year 1916 was so dry that an unusually large acreage of the cabbage planted was not harvested. The acreage reported planted in New York in 1915 was 38,600, and that harvested was 35,900, a difference of 2700 acres (table 24). In 1916 the acreage reported planted in New York

TABLE 24. NEW YORK STATE CABBAGE PRODUCTION AS PREDICTED, COMPARED WITH FINAL PRODUCTION REPORT FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE

Year	Acreage harvested, including Long Island	Expected production, using average yield per acre (8 tons) for the four years from 1911 to 1914 (thousands of tons)	Rainfall, in per cent of normal	Expected production corrected for rainfall, or predicted production (thousands of tons)	Final U. S. Dept. Agr. report of production for New York including Long Island (thousands of tons)	Per cent above or below final report
1915	35,900	287	151	434	359	+21
1916	17,800	142	72	103	96	+ 7
1917	28,300	226	102	231	207	+12
1918	28,000	224	104	233	255	− 9
1919	20,120	161	90	145	131	+11
1920	31,147	249	126	314	345	− 9
1921	27,045	216	88	190	176	+ 8
1922	29,395	235	104	245	274	−11
1923	26,880	215	71	153	200	−24
Total	....	....	....	2,048	2,043	....
Average	....	....	....	....	....	12
1924	27,580	221	148	327	306	+ 7

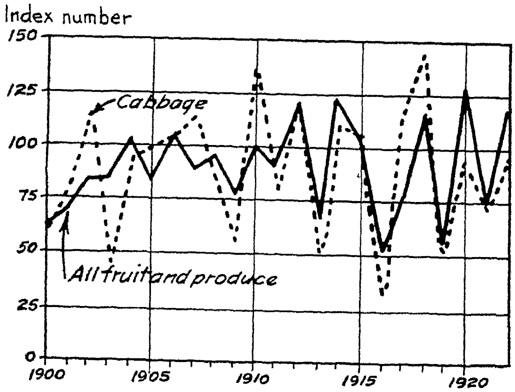


FIGURE 13. VARIATIONS IN TONNAGE OF CABBAGE AND OF ALL FRUIT AND PRODUCE ORIGINATING ON THE ELMIRA DIVISION OF THE PENNSYLVANIA RAILROAD

(Average for five years from 1910 to 1914 = 100)

was 25,100, and that harvested was 17,800. In Wisconsin the plantings reported were 14,300 for 1915 and 11,000 for 1916, and the acres harvested were 13,500 in 1915 and 9200 in 1916.[5] Very dry weather in May and June results in a poor stand of plants in the seedbed, as well as less vigorous plants for setting. In some instances, shortage of plants in years of dry May and June causes a reduction in acreage set.

The study of rainfall helps in predicting the pro-

[5] U. S. Agr. Dept. Monthly Crop Report for December, 1916, vol. 2, p. 122.

duction of all farm products, and thus may be of use to railroads in providing the adequate number of cars in the various territories comprising the system, and in otherwise planning with greater precision the management of shipments.

The annual tonnage shipments of all fruit and produce, and of cabbage, shipped from stations in New York on the Elmira Division of the Pennsylvania Railroad, are given in figure 13, on an index-number basis. In each case the average for the five years from 1910 to 1914 is taken as

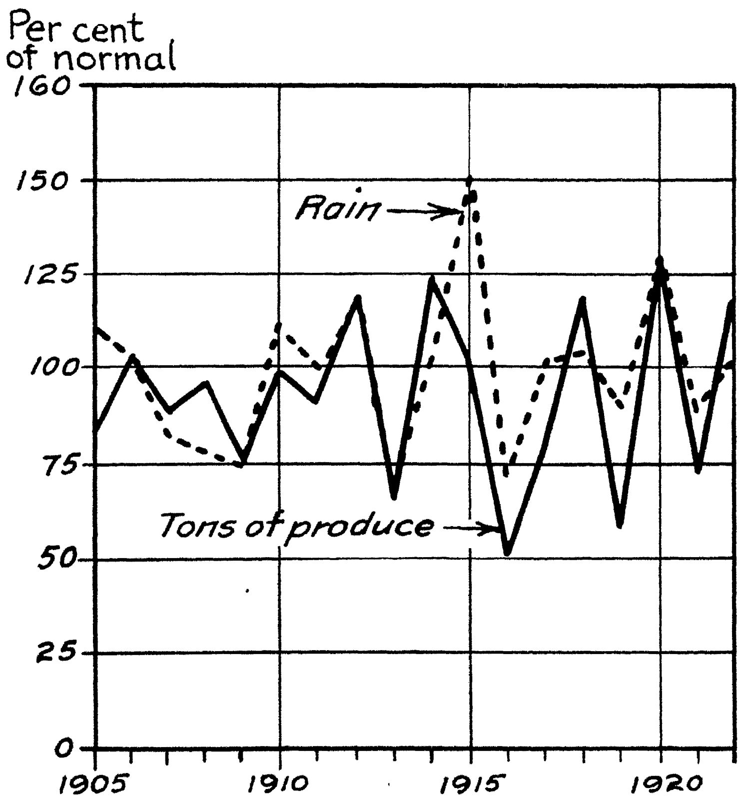


FIGURE 14. RAINFALL IN WESTERN NEW YORK, AND TONS OF FRUIT AND PRODUCE ORIGINATING ALONG THE ELMIRA DIVISION OF THE PENNSYLVANIA RAILROAD

100 (table 25). This information was furnished by Henry K. Ball, district freight representative. The points illustrated by the chart are the wide fluctuations in the production of farm produce in this section, and the greater variation in the shipment of cabbage during this period than in shipments of other products, which indicates again that the production of cabbage is particularly sensitive to weather conditions.

The variations in the annual July, August, and September rainfall at the stations included in table 18 (page 31), and the variations in the annual tonnage shipments of all fruit and produce originating along the Elmira

Division of the Pennsylvania Railroad, both in percentage of normal, are shown graphically in figure 14. The close relation of the required number of cars to the amount of rainfall also is shown here.

TABLE 25. INDEX NUMBERS OF TONS OF ALL FRUIT AND PRODUCE, AND OF CABBAGE, ORIGINATING AT NEW YORK STATIONS ON THE ELMIRA DIVISION OF THE PENNSYLVANIA RAILROAD

(Average for the five years preceding the war, 1910 to 1914,=100)

Year	Fruit and produce (tons)	Cabbage (tons)
1900*	62	60
1901*	72	86
1902*	84	116
1903*	84	45
1904*	104	94
1905	83	100
1906	104	105
1907	89	115
1908	96	88
1909	76	55
1910	100	137
1911	91	79
1912	119	122
1913	66	50
1914	124	111
1915	102	105
1916	51	32
1917	78	111
1918	117	144
1919	58	52
1920	129	94
1921	72	72
1922	119	96

* Grapes not included.

Comparison of these index numbers of railroad tonnage with the rainfall data given in table 19 shows the close correspondence between variations in rainfall and variations in freight movements of farm products. The question of the relation of the amount of rainfall to freight movements is one of considerable economic importance, and observance of certain facts in this connection would probably expedite the movement of farm products.

The question of car shortage is very important from an economic standpoint to farmers and to railroad companies. With such crops as cabbage, apples, and potatoes, so subject to weather conditions, the total movements and the direction of the movements therefore vary widely from year to year.

SEASONAL MOVEMENTS OF NEW YORK CABBAGE

In New York the domestic crop is ready for shipment in September. The movement of a number of carloads of this stock for short distances to sauerkraut factories precludes the car-lot shipments from indicating the actual movement to cities for consumption

The usual movement of New York cabbage in September is from 300 to 1000 carloads. The movement in October, when the harvesting of the late cabbage begins in the regions of a shorter growing season such as in Chenango and Cortland Counties, is from three to five times the September shipments. The western New York late cabbage moves during the latter part of October and the first half of November. The shipments in November are about four-fifths of the October movement, and in December slightly more than one-half of the November movement. In January, shipments almost always increase over the December shipments, as dealers are usually moving storage stock in considerable volume at this time. It seldom pays to store for one month, and for this reason very little is moved out of good storage in December, unless the dealers consider that they are likely to lose money by holding longer.

The movements of New York State shipments in each month over a period of several years are shown in table 26 and figure 15.

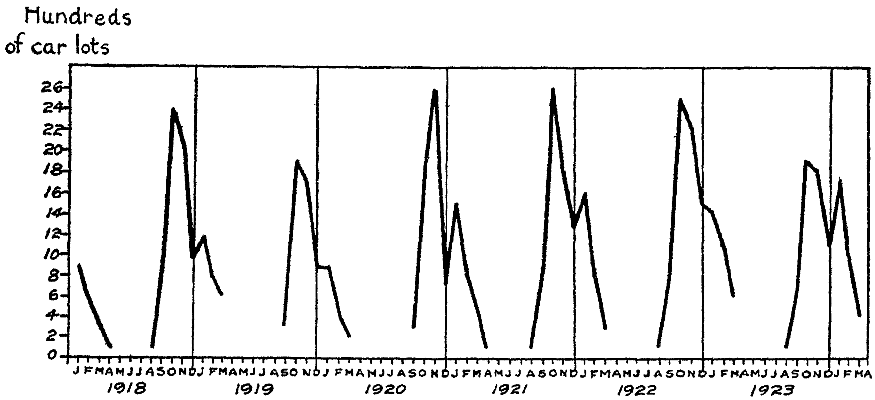


FIGURE 15. MONTHLY CAR-LOT SHIPMENTS OF CABBAGE ORIGINATING IN NEW YORK STATE, FROM 1918 TO 1923, INCLUSIVE

(Data from the Bureau of Agricultural Economics of the United States Department of Agriculture)

Of the New York State cabbage shipments from August to April for the seven years from 1917 to 1923, inclusive, the percentage shipments each month were as follows: August 0.9, September 8.1, October 27.2, November 23.9, December 12.9, January 14.1, February 8.1, March 4.3, and April 0.5. If it is considered that the August, the September, and half of the October shipments are domestic cabbage, and the remainder Danish, then, as a seven-years average, 48.5 per cent of the Danish crop is shipped by December 1, 65.1 per cent by January 1, 83.3 per cent by February 1, and 93.8 per cent by March 1.

DESTINATION OF NEW YORK CABBAGE

According to a report of the United States Bureau of Agricultural Economics, more than half of the New York cabbage goes to cities of 250,000 population or over.[6] A very small proportion goes to cities of

[6] Western and central New York cabbage deal, season 1922–23. U. S. Dept. Agr., Bur. Agr. Econ., Div. Fruits and Vegetables. Mimeographed report by C. L. Brown. August, 1923.

TABLE 26. CAR-LOT SHIPMENTS OF CABBAGE ORIGINATING IN NEW YORK STATE*

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total for year
1917	328	51	8	......	......	....	..	9	618	2,233	1,296	574	5,117
1918	923	638	263	117	.....	.	4	149	1,032	2,390	1,978	974	8,468
1919	1,237	804	598	34	.....	...	..	13	295	1,887	1,687	948	7,503
1920	944	412	178	18	1		2	18	292	1,672	2,587	736	6,860
1921	1,504	796	506	63	.....	....	.	139	789	2,638	1,784	1,324	9,543
1922	1,550	766	256	22	......	....	1	108	838	2,511	2,224	1,499	9,775
1923	1,393	1,084	580	26	1	.	1	62	694	1,926	1,833	1,139	8,739

*Data for the years 1917 to 1920, inclusive, are from Bulletin 982 of the United States Department of Agriculture, p. 228–229, 1921; for the period from the beginning of 1921, thru October, 1923, from the United States Bureau of Agricultural Economics; and for November and December, 1923 from a mimeographed report from C. L. Brown, Rochester, New York.

25,000 population or less, because enough is usually grown in the immediate vicinity of such places, and trucked in, to supply the demand. Most of the cars have markets within a radius of from 150 to 300 miles. The principal cities receiving New York cabbage are New York, Philadelphia, Baltimore, Pittsburgh, Boston, Newark, Cincinnati, Cleveland, and Washington. However, small villages, cities, and mining towns, located in regions not adapted to cabbage production, provide a good market for the crop, because the price that can be obtained there is not so dependent upon the amount of cabbage received in the market as it is in the markets of large cities. Only enough to supply the demand at a fair price is brought into such towns, and thus a firm price is maintained.

A report of the United States Department of Agriculture for January, 1916, gave a summary of the varieties of cabbage grown and the percentage of each type of cabbage shipped out of the county where it was grown.[7] This report shows that Minnesota, Wisconsin, New York, and Colorado grow the smallest proportion of domestic cabbage to the total amount of cabbage grown, and a larger proportion of the Holland and Danish cabbage is shipped out of the county where it was grown in these States than in any other late-cabbage-growing State.

SHIPPING AND STORAGE OPERATIONS AT LITTLE YORK, NEW YORK

The information given in many of the succeeding parts of this bulletin was obtained thru the cooperation of Mr. F. N. Salisbury, of Little York, New York, who has kept complete and systematic records of his produce transactions at this place for many years, and who generously gave the writer the privilege of summarizing his records for the purposes of this publication.

Little York is on the Syracuse-Binghamton Division of the Delaware, Lackawanna & Western Railroad, 30 miles from Syracuse, 50 miles from Binghamton, and 250 miles from New York. It is 5 miles north of Homer, on a concrete highway. A loading switch was maintained there for several years after the construction of the railroad. Then the road was double-tracked, and no switch nor loading facilities were available. It was at that time that the growing of cabbage began in that region, and the first cabbage was hauled to Homer for shipment. Shortly afterward the farmers donated to the railroad company the use of a strip of land $1\frac{1}{2}$ rods wide for a loading switch.

The first cabbage produced along this railroad was said to have been grown about 1885 by a farmer, David Carver, on the farm owned in 1923 by Robert Wright, one-half mile from the Little York Station. Carver gradually increased his acreage of this crop to some four or five acres, hauling the cabbage to Homer for shipment until in 1888 switching facilities at Little York permitted shipping from there. Mr. Salisbury states that he loaded the first car shipped from Little York in 1888, for David Carver.

The first cabbage raised was the early or domestic strain called *Flat Dutch*, or *Brunswick*. Then the Warren was grown. Shortly afterward a domestic variety called *Ideal* was introduced. All the early cabbage was white, for red cabbage was not popular in the early days of cabbage raising.

[7] U. S. Agr. Dept. Monthly Crop Report, vol. 2, p. 5. 1916.

In the first few years, the common method of raising cabbage was to plant the seed in hills about 2½ by 3 feet. The result was from two to six plants in a hill. As hoeing progressed, the plants were thinned out and reset. Later a few were planted in hills and extra plants were grown for setting. Then the seed was drilled in rows in a seedbed. Now the almost universal practice in the section is to broadcast the seed, a method which results in producing stockier plants.

All of the above-named varieties were fall-shipment cabbage. Sometimes the heads were cut and piled, and sometimes set down, so that occasionally a few cars might be shipped as late as the first of December. Stock cars were used in the first years, and these were loaded full, holding about 20 tons. These are not used now unless an order for the South calls for such a car.

With the expanding market for cabbage and the increasing purchasing power of the price received for it, the methods of handling the crop in transportation have been refined. Farmers are more careful to see that the cabbage is delivered unbruised to the buyer. Cars are loaded more systematically, so that the ventilation between the cabbage heads is better and there is less shifting in transit. As a reflection on the careless methods that were sometimes used in the earlier years, when the crop was cheap and the freight rates were low, it has been said that the slats were sometimes knocked off from stock cars and the heads pitched in with a fork.

The present practice is to use refrigerator cars for September shipments, either with standard ventilation or iced. From the middle of October to the middle of November, box cars are used, and from then on refrigerator cars are used, with standard ventilation or closed, according to the weather.

In the early years consumers did not expect cabbage trimmed for the kettle, as they do now. More leaves were left on, and occasionally a request would come for part of a carload to be pulled up, probably to be sold to persons who would bury it for winter use.

In the early nineties, possibly about 1895, Russell Oakes at Homer built the first cabbage storehouse in Cortland County, on the farm just north of Homer occupied in 1923 by Fred Eldridge. This storehouse held about 100 tons of cabbage. It was torn down in the summer of 1923.

The first cabbage ever stored at Little York was stored on the ground, about 1895, on what is now the Rollin Wright farm, for T. B. Shaul, of Baltimore, Maryland. Mr. Salisbury had charge of this cabbage. It came thru a cold winter in good condition.

At present the almost universal practice of storing cabbage on the ground is to place the heads with the stump end on sod, as closely together as possible, and cover them with hay. Swale hay is the best for this purpose, as it does not rot so quickly nor carry so many leaves and seeds as do other kinds. Straw is not so successful, as it carries too much chaff, decomposes quickly, and does not shed water well. In many cases a mixture of straw and hay is used.

Cabbage should be loaded so that it will make a good appearance when it reaches the market. Stacked cabbage, faced with heads of uniform average size and secured by neat bulkheads, makes the car attractive and prevents the cabbage from shifting during transit. Old cabbage that

has been in storage for some time should be carefully trimmed when loaded, so that evidences of decay are removed. Heads that have decayed so badly that very close trimming is necessary should be kept at home. The shipper should always remember that small heads, heads showing traces of decay, and heads trimmed so closely that the outer green leaves are all removed or only the center part of the head remains, even tho there are only a small number of such heads in a car, give an unfavorable impression. If top prices are expected, particular care should be taken with late-season shipments of old stock.

In cold or changeable weather, cabbage sometimes arrives frozen or frosted. If it is accepted, the wholesale receiver must put in a heater to thaw it out, and handle over the heads worst affected before sacking and selling. This means extra expense, possibly demurrage charges, and a tendency for jobbers to avoid such stock and to look for shipments that have arrived in better condition. It is therefore of advantage to the shipper, not only to send good stock, but to take every precaution to assure its arrival in good condition.

On January 31, 1924, the writer inspected a car of cabbage at the New York Central docks in Brooklyn, sold by a broker. The cabbage was good stock, in new sacks, stamped "Extra Fancy Cabbage." The refrigerator car had not been lined with paper, however, as it might have been in cold weather, and no straw had been laid over the false floor. Consequently the cabbage was so badly frozen that the purchaser refused to accept it. Shipping-point inspection, unless it assures the purchaser that precautions have been taken against damage in transit, will not prevent such injury.

On the same day the writer inspected another car of firm, good-colored, bulk stock in the Lehigh Valley yards at West Twenty-seventh Street, New York, which was so badly frosted that a heater had been set up, and the cabbage was being handled over to thaw it out. On an adjoining switch was a carload of stock that had not kept well in storage, had been trimmed severely (including the cutting-off of decayed spots with a knife), had some cracked heads, and altogether was not of the best quality. All of these conditions depress the price, and show that it is the supply, backed by quality and coupled with the demand, that settles the price.

The number of whole carloads, tons of cabbage, and average weight per car, that were handled each season by Mr. Salisbury during a period of twenty-eight years as agent for several firms, are shown in table 27:

TABLE 27. NUMBER AND SIZE OF CAR-LOT SHIPMENTS OF BOTH STORED AND STREET CABBAGE FROM LITTLE YORK

Year	Number of whole carloads	Tons of cabbage	Tons per car
1894–95	70	1,181.5	16.9
1895–96	48	697.5	14.5
1896–97	38	590.9	15.6
1897–98	31	485.0	15.6
1898–99	25	395.4	15.8
1899–1900	29	492.6	17.0

TABLE 27 *(concluded)*

Year	Number of whole carloads	Tons of cabbage	Tons per car
1900–01	36	568.1	15 8
1901–02	90	1,340.5	14.9
1902–03	31	429.6	13.9
1903–04	25	352.7	14.1
1904–05	29	398.1	13.7
1905–06	50	713.0	14.3
1906–07	91	1,312.2	14.4
1907–08	64	841 0	13.1
1908–09	45	589.4	13.1
1909–10	105	1,342.8	12.8
1910–11	167	2,179.2	13.0
1911–12	104	1,319.4	12.7
1912–13	87	1,172.9	13.5
1913–14	85	1,067.4	12.6
1914–15	99	1,211.9	12.2
1915–16	62	776.9	12.5
1916–17	48	594.9	12.4
1917–18	106	1,413.1	13.3
1918–19	86	1,133.8	13.2
1919–20	29	385 4	13 3
1920–21	76	996.9	13.1
1921–22	75	950.9	12.7

The average weight of carloads was much higher in earlier years, averaging from 13 to 17 tons to a car, but in recent years it has been from 12.2 to 13.5 tons to a car. Cars of storage stock contained slightly less than did cars of stock bought from the street (tables 28 and 29).

TABLE 28. NUMBER AND SIZE OF CAR-LOT SHIPMENTS OF CABBAGE FROM LITTLE YORK, NOT STORED

Year	Number of whole carloads	Tons of cabbage	Tons per car
1894–95	70	1,181 5	16.9
1895–96	48	697.5	14.5
1896–97	38	590.9	15.6
1897–98	31	485 0	15.6
1898–99	25	395.4	15.8
1899–1900	29	492.6	17.0
1900–01	36	568.1	15.8
1901–02	90	1,340.5	14.9
1902–03	31	429.6	13.9
1903–04	25	352.7	14.1
1904–05	29	398.1	13.7
1905–06	40	574.6	14.4
1906–07	66	968.0	14.7
1907–08	37	502.3	13.6
1908–09	21	282.7	13.5
1909–10	61	791.7	13.0

TABLE 28 (*concluded*)

Year	Number of whole carloads	Tons of cabbage	Tons per car
1910–11	134	1,772.1	13.2
1911–12	67	865.2	12.9
1912–13	49	671.8	13.7
1913–14	58	732.7	12.6
1914–15	45	564.3	12.5
1915–16	39	501.6	12.9
1916–17	23	296.7	12 9
1917–18	87	1,165.5	13.4
1918–19	57	768.4	13.5
1919–20	29	385.4	13.3
1920–21	42	565.2	13.5
1921–22	36	466.0	12.9

TABLE 29. NUMBER AND SIZE OF CAR-LOT SHIPMENTS OF STORAGE CABBAGE FROM LITTLE YORK

Year	Number of whole carloads	Tons of cabbage	Tons per car
1905–06	10	138.4	13.8
1906–07	25	344.2	13.8
1907–08	27.	338.7	12.5
1908–09	24	306.7	12.8
1909–10	44	551.1	12.5
1910–11	33	407.1	12.3
1911–12	37	454.2	12.3
1912–13	38	501.1	13.2
1913–14	27	334.7	12.4
1914–15	54	647.6	12.0
1915–16	23	275.3	12.0
1916–17	25	298.2	11.9
1917–18	19	247.6	13.0
1918–19	29	365.4	12.6
1919–20	..	.....	....
1920–21	34	431.7	12.7
1921–22	39	484.9	12.4

Shippers of produce usually guarantee weights of cabbage within 5 per cent. Some jobbers have complained that occasionally a shipper would apparently send short weight, as the entire 5 per cent was lacking when other cars arriving at the same time would not be short the 5-per-cent allowance for shrinkage. The ordinary loss in weight in transit is usually not more than half this amount. A creditable policy of some cooperative associations is to send enough to cover shrinkage in transit. The full weight then arrives, the jobber is pleased, and mutually advantageous business relations are encouraged.

Producers frequently fail to appreciate the service rendered by produce dealers. One dealer, with his weighing scales, loading platforms, and other facilities, and his contact with city jobbers, can do the business for from thirty to fifty growers more efficiently than they can do it for themselves. Furthermore, the heavy production of cabbage that prevails, the competition, and the falling markets, prevent such a dealer from realizing excessive profits in most years. Whenever cooperative marketing associations attempt to offer a loading, shipping, or selling service to growers, it must be expected that this service can succeed only if it can be rendered more cheaply or a better net price can be obtained for the grower. This is very difficult to do with a perishable crop such as cabbage, so subject to changes in price.

The total amounts of white and of red cabbage purchased each month for many years by Mr. Salisbury, as loader, at Little York, are shown in tables 30 and 31. In his twenty-eight years of experience, Mr. Salisbury purchased about 28,000 tons. Of this amount, 5 per cent was purchased in September, 39 per cent in October, 23 per cent in November, 6 per cent in December, 14 per cent in January, 8 per cent in February, 4 per cent in March, and 1 per cent in April. Two-thirds of all the cabbage was purchased before December 1, and, since most of the loading at this point was done by Mr. Salisbury, this indicates that for the twenty-eight years in question the farmers in this vicinity have held only one-third of their cabbage after December 1. Of the 28,000 tons, about 1 per cent was red.

The amount of cabbage put into storage at Little York each day thruout a period of fourteen years is shown in table 32 and in figure 16.

TABLE 30. AMOUNTS OF CABBAGE PURCHASED BY F. N. SALISBURY, AGENT, AT LITTLE YORK, BY MONTHS

Year	Tons of cabbage									
	September	October	November	December	January	February	March	April	May	Total tons
1894–95	...	322.0	246.5	412.7	141.0	59.3	...	...	...	1,181.5
1895–96	...	203.8	352.9	140.8	...	...	...	...	...	697.5
1896–97	...	77.3	257.2	66.4	83.8	78.5	27.7	...	...	590.9
1897–98	12.6	137.9	138.7	14.6	181 2	...	...	...	...	485.0
1898–99	98.5	115.6	181.3	...	...	...	...	...	...	395.4
1899–1900	...	162.5	227.0	14.8	45.8	42.5	...	...	...	492.6
1900–01	25.0	97.9	120.3	...	153.1	177.5	...	...	...	573.8
1901–02	174.7	224.4	250.6	177.5	288.9	107.6	128.3	...	...	1,352.0
1902–03	12.1	71.4	46.8	39.1	80.7	69.9	13.0	96.6	...	429.6
1903–04	...	137.8	29.7	66.7	127.5	...	...	...	...	361.7
1904–05	13.3	102.1	...	13.4	87.6	69.9	61.9	57.9	...	406.1
1905–06	87.0	158.7	119.0	24.0	77.0	82.4	44.7	11.4	...	604.2
1906–07*	162.2	733.6	308.5	27.8	125.6	102.5	28.1	27.9	7.5	1,523.7
1907–08*	53.0	460.4	175.5	17.4	157.2	59.9	50.0	...	...	973.4
1908–09	43.5	355.2	105.9	64.0	133.4	51.7	...	11.4	...	765.1
1909–10	115.3	548.6	414.7	107.1	248.5	76.1	10.3	9.8	...	1,530.4
1910–11	92.8	683.1	409.7	187.5	474.1	279.2	203.9	27.9	...	2,358.2
1911–12	39.5	734.0	208.7	20.7	284.7	222.5	28.9	...	...	1,539.0
1912–13	67.7	880.9	275.9	26.4	29.7	12.0	13.5	...	...	1,306.1
1913–14	24.2	615.1	121.1	112.1	198.9	85.4	124.2	48.5	...	1,329.5
1914–15	85.4	786.9	293.8	26.5	223.7	171.2	94.5	...	...	1,682.0
1915–16	...	242.1	403.4	12.9	68.2	56.9	143.2	57.5	...	984.2
1916–17	39.4	382.8	184.6	50.3	30.5	11.8	...	...	...	699.4
1917–18	50.7	434.4	445.5	129.0	312.7	157.8	75.9	15.9	...	1,621.9
1918–19	169.8	776.7	120.3	38.4	147.5	45.2	57.4	...	...	1,355.3
1919–20	25.4	669.5	85.3	49.7	43.7	...	...	...	...	873.6
1920–21	...	74.1	877.4	14.2	29.8	54.4	36.3	...	...	1,086.2
1921–22	83.7	761.2	55.6	...	49.6	61.7	11.8	...	...	1,023.6
Total:										
White	1,475.8	10,950.0	6,455.9	1,854.0	3,824.4	2,135.9	1,153.6	364.8	7.5	28,221.9
Red	...	138.4	103.1	2.4	6.8	4.7	...	...	...	255.4
Per cent of season's total	5.2	38.9	23.0	6.5	13.5	7.5	4.1	1.3	0	100.0

* For these two years the purchases of cabbage stored were not separated into months on the books. The amount was apportioned to October and November on the basis of purchases for storage in later years.

TABLE 31. TONS OF RED CABBAGE PURCHASED BY F. N. SALISBURY, BY MONTHS

Season	October	November	December	January	February	Total
1905	3.1	15.8	....	....	....	18.9
1906*	....	....	....	...	....	....
1907*	1.2	....	....	6 0	....	7.2
1908	15.5	1.1	1.5	.. ..	....	18 1
1909	36.7	40.7	....	....	....	77.4
1910	20.7	29 7	....	.....	....	50.4
1911	20.7	2 9	....	0 8	4 3	28.7
1912	5.1	1.1	....	....	....	6.2
1913	6.8	....	....	....	....	6.8
1914	5.7	....	0 9	....	0.4	7.0
1915	....	....	....	....	....	....
1916	15 1	4.0	....	....	....	19 1
1917	....	....	....	....	....	....
1918	4.5	3.2	....	....	....	7.7
1919	....	....	....	....	....	....
1920	....	4.6	....	....	....	4 6
1921	3 3	....	....	....	....	3.3
Total	138.4	103.1	2.4	6.8	4.7	255.4

*After this bulletin was in proof, the following error was discovered: for 1906, 1.9 tons of red cabbage put into storage, and for 1907, 45.5 tons, were included with the white cabbage in table 30 and omitted from the red cabbage in table 31.

The time of filling a storage depends upon when the crop is ready, the weather conditions, and the price. Some dealers prefer to store fairly early

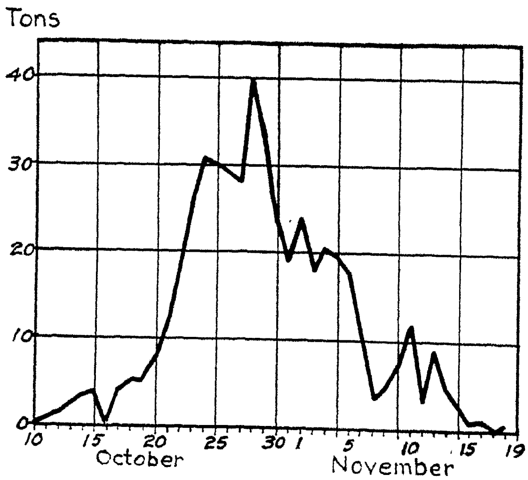


FIGURE 16. DAILY AVERAGE FOR FOURTEEN YEARS, 1908 TO 1921, INCLUSIVE, OF CABBAGE PUT INTO THE STOREHOUSE AT LITTLE YORK

if the weather is not too warm, before the coming of rains, light snows, and freezing weather. The cabbage then enters the storage in better condition, and shrinkage is less.

	Tons of cabbage													
	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
October 1						4.8								
11														10.9
12														18 3
13														34 1
14														44.4
15														52 2
16						1.7								
17				5.1		19.0			1 6					32 9
18				8.3	9.6	6.6					8 4			40 2
														2.9*
19				20.3	4.3									42.2
20	3.7			37.2		5.9			4.6			32.3		18 7
21	17.8			44.9	2.3		3 0		4.3		27.2	43 3		23 5
22					1.4*									
	20.0				23.0	24.8	32.1				50 9	54.1		47.6
23	0.3*			2.2*	1.1*									
	6.5			41.2	36.8	44.7	74.7		14.8		67.7	70 8		
24				2.8*			3.0*							
	17.7		3.3	59.9	32 8	5.5	81.4		17.1		72.7	69.5		61.8
25		1.5*		3.3*										0.4*
		25.4	9.7	57 9	81 5	39.9			23.8		47.4	84.2		47.3
26	0.6*	3.1*							2.5*					
	24.2	58.4	21.2	47.5	65.1		93.1	12.7	14.8	1.3	36.6			28 1
27	4.0*	8.9*		3.3*					2 6*					
	46.9	92.3	12.0	22.1		60.2	9.5	21.8	21 8	1 0	20.4	35 1		26.1
28	2.7*	12.2*		8.0*					3.0*					
	36.9	71 7	37.9	38 5	41.7	79.5	77.5	39 4	25 5		35.9	32.9		16.4
29	4.9*	4.0*	2.2*		0.5*	6.8*	0.8*				1.0*			
	59.6	32.0	43.3		66.5	69.4	72.8	34.7		1.4	45.3	21.0		5 1
30		7.0*		1.1*	2.1*				2.7*					
	53.9	16.9		33.9	57.9	54.3	39.7	29.3	21.5	1.5	16.5			
31	0.9*		1.4*						4.3*		3.5*			
	30.2		72.0	8.2	17.0	29.8	32.4		34.0		23.5	4.7		
Total: Red	13.4	36 7	3.6	20.7	5.1	6.8	3.8		15.1		4.5			3.3
White	317.4	296.7	199.4	425.0	438.5	446.1	516.2	137.9	183.8	5.2	452.5	447.9		549.8

* Red cabbage.

TABLE 32 (*concluded*)

	Tons of cabbage													
	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
November 1...	....	7.8*	18.8*	.....	0.6*	.....	.....	.....	1.0*	.....	2.5*	.....	.....	......
	0.9	63.7	73.6	23.7	31.4	10.4	9.5	44.4	25.6	.....	15.3	7.9	.....	......
2...	0 5*	11.0*	2.9*	.....	.....	.....	.....	.....	0 8*	.....	.....	.....	.....	......
	10.2	31.7	37.7	7.8	12.2	.....	.....	42.5	33.0	.....	33.5	.....	30.0	......
3...	....	.....	2 8*	.....	.....	.....	.....	.....	0.5*	.....	.....	.....	.....	......
	7.4	8.0	55.8	5 5	.....	14.2	4.6	42.2	26.6	4.2	.....	7.1	105.6	......
4...	17.1	7 1	14.5	10.8	13.0	11.3	10.3	41.4	22.5	. . .	2.3	4.6	117.7	......
5...	0.6*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	......
	5 9	10.2	16.0	...	10.8	11.7	.....	49.5	.....	.....	4.6	3.8	126.2	3.4
6...	2.7	...	.....	8.6	11 8	2.5	1.4	34.1	11.7	3.8	.....	.....	79 5	......
7...	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.1*	....	.....	......
	4.5	.....	7 4	1.9	.....	6.8	.....	.....	19 0	4 3	.....	.....	.....	......
8...	....	.....	.....	.....	.....	.....	.....	.....	1.1*	.....	.....	.....	2.5*	......
	...	.....	1.3	.....	1.8	.....	.....	18.0	8 4	5.2	.....	....	27.0	......
9...	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0 6*	.....	.....	......
	16.3	.....	16.3	.....	.....	....	.....	8 8	6 3	52.2	0.4	.....	.....	......
10...	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.1*	......
	12.4	.....	19.1	.....	.....	.....	.....	6 0	7.4	94.6	3.3	.....	22.9	......
11...	3.8	.....	18.6	.....	.....	.....	.....	4 6	11 5	.....	1.2	.....	.....	......
12...	13.9	.....	11 2	....	.....	.....	.....	5 5	.....	89.6	1.2	.....	....	......
13...	6.9	.....	.....	....	...	....	....	1.2	1 6	51.0	...	.....	.....	......
14...	3 9	...	3 3	....	...	.....	.....	.	....	21.5	1.2	.....	.....	......
15...	.....	.....	2.0	....	..	1.7	.....	...	....	4.1	.....	.....	.....	......
16...	....	.....	.....	....	....	.....	.....	.....	..	10.3	.....	.....	.....	......
17...	....	.....	....	....	.	...	.....	.....	...	1 7	.....	.....	.....	......
18...	....	.....	....	.....	.	....	.....	.....	4 6	.....	.....	.....	....	......
19...	.. ..	....	. .	.....		. ..	.....	.....	. .	.....	.....	.....	....	......
20...	.....	.. ..	.	.....	.	.....	.....	....	1 1	.....	.....	.. .	.....	......
21...	.....	..	. ..	... .	. .	... .	.....	....	1 2	.....	.....	.....	.....	......
22...	.....	. ..	. ..	... ..	.	.....	.....	.. ..	0.4	. ...	.....	.....	.....	......
23...	.....	..	..	.... .	. .	. ..	.....	... .	.. .	...	.....	.....	.....	......
24 ..	.. .	..	... .	. .	. ..	.....	.....	... .	...	.....	.....	.....	.... .	.....
25	. ...	....	.. .	.. .	...	.. .	.....	...	.....		.. ..	....	.....	......

26...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	......
27..	.....	.. ..	.....	.....	.....	.....	.. ..	.....	.....	.....	.....	.....	.....	......
28...	. ..	.....	.....	.....	.....	.....	.....	1.5	.....	.....	.....	.....	.....	......
29...	.....	.....	.....	.....	.....	.....	.....	.....	2.6	.....	.....	.....	.....	......
30...	....	.....	.....	.....	.....	.....	.....	.....	0.6*	.....	.....	.....	.....	......
	....	.....	.....	.....	.....	.....	.....	.....	1.1	.....	.....	.....	.....	......
Total: Red....	1.1	18.8	24.5	.....	0.6	.....	.....	.....	4.0	.....	3.2	.....	4.6	......
White..	105.9	120.7	276.8	58.3	81.0	58.6	25.8	299.7	184.6	342.5	63.0	23.4	508.9	3.4
December 3....	1.5*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	......
Grand total:														
Red.......	16.0	55.5	28.1	20.7	5.7	6.8	3.8	.....	19.1	.....	7.7	.....	4.6	3.3
White......	423.3	417.4	476.2	483.3	519.5	504.7	542.0	437.6	368.4	347.7	515.5	471.3	508.9	553.2

* Red cabbage.

The total amounts of cabbage put into and taken out of the storehouse at Little York, for the years from 1907 to 1921, inclusive, with the shrinkage, are given in table 33. The amount stored annually in this storehouse varied from 348 to 556 tons. The shrinkage and losses, calculated on the basis of the amount stored, were from 7.4 to 27.6 per cent. The total shrinkage on 6690 tons of cabbage put into the storehouse in the fourteen years from 1907 to 1921, excepting the year 1919 when information was not available because the contents of the storehouse were sold to a second party, was 1061 tons, or 15.9 per cent of the tonnage stored. The total shrinkage on 1477 tons of cabbage stored on the ground (in 1906, 510 tons; in 1909, 259 tons; in 1910, 37 tons; in 1911, 132 tons; in 1912, 92 tons; in 1914, 447 tons) was a total of 316 tons, or 21.4 per cent

FIGURE 17. CABBAGE STOREHOUSE AT LITTLE YORK

of the tonnage stored. The shrinkage on 8167 tons of both house- and ground-stored cabbage was 1377 tons, or 16.9 per cent of the tonnage stored.

In the season of 1920–21, 4.6 tons of red cabbage were stored and 4.4 tons were taken out, showing a shrinkage of 4.3 per cent on the small amount of red cabbage that year. In the season of 1913–14, 6.8 tons of red cabbage were stored in bins and 5 tons were removed, showing a shrinkage of 1.8 tons, or 26.5 per cent of the tonnage. In recent years practically no red cabbage has been stored, and also less has been grown than was grown about ten years ago. The total amount of red cabbage stored in the storehouse for the period studied was 217 tons, and the shrinkage was 38 tons, or 17.8 per cent of the amount stored.

Shrinkage of cabbage in house storage depends chiefly on two factors — the number of days in storage, and the temperature during November and December. The longer the storage period, the greater is the shrinkage. The higher the temperature in November and December, the more

TABLE 33. AMOUNTS OF CABBAGE PUT INTO AND TAKEN OUT OF STORAGE AT LITTLE YORK

Year	Tons put into storage									Tons taken out of storage			Shrinkage, in tons	Shrinkage and loss, in per cent of amount stored
	White Danish			Red			Total			White	Red	Total		
	Bins	Driveway	Total	Bins	Driveway	Total	Bins	Driveway	Total					
House storage														
1921	500.5	52.7	553.2	3.3	......	3.3	503.8	52.7	556.6	482.0	2.9	484.9	71.6	12.9
1920	464.8	44.1	508.9	4.6	......	4.6	469.4	44.1	513.5	436.5	4.4	440.9	72.6	14.1
1919*	471.3	.	471.3	......	......	......	471.3	......	471.3	......	......	......	....	....
1918	515.5	....	515.5	......	......	7.7†	......	......	523.2†	406.4	6.2	412.6	110.6	21.2
1917	347.7	......	347.7	.	....	......	347.7	......	347.7	319.3	......	319.3	28.4	8.2
1916	368.4	......	368.4	19.1	....	19.1	387.5	......	387.5	330.5	17.1	347.6	39.9	10.3
1915	437.6	......	437.6	.....	.....	.....	437.6	......	437.6	324.1	......	324.1	113.5	25.9
1914	456.9	85.1	542.0	3.8	......	3.8	460.7	85.1	545.8	392.8	2.4	395.2	150.6	27.6
1913	444.7	60.0	504.7	6.8	......	6.8	451.5	60.0	511.5	419.2	5.0	424.2	87.3	17.1
1912	438.5	81.0	519.5	5.1	0.6	5.7	443.6	81.6	525.2	447.5	4.2	451.7	73.5	14.0
1911	406.9	76.4	483.3	20.7	......	20.7	427.6	76.4	504.0	386.0	13.8	399.8	104.2	20.7
1910	405.7	70.5	476.2	28.1	......	28.1	433.8	70.5	504.3	436.6	25.9	462.5	41.8	8.3
1909	390.0	27.4	417.4	55.5	......	55.5	445.5	27.4	472.9	370.2	41.8	412.0	60.9	12.9
1908	423.3	......	423.3	16.0	......	16.0	439.3	......	439.3	351.5	12.6	364.1	75.2	17.1
1907	361.0	14.9	375.9	45.5	......	45.5	406.5	14.9	421.4	348.3	42.0	390.3	31.1	7.4
Ground storage														
1914	......	......	444.6	......	......	1.9	......	......	446.5	351.2	1.7	352.9	93.6	21.0
1912	......	......	92.2	......	......	......	......	......	92.2	71.8	..	71.8	20.4	22.1
1911	......	......	129.2	......	......	2.9	.	......	132.1	112.8	2.6	115.4	16.7	12.6
1910	......	......	36.7	......	......	......	......	......	36.7	35.5	.	35.5	1.2	3.3
1909	......	......	242.5	......	......	16.4	......	......	258.9	184.0	11.7	195.7	63.2	24.4
1906	......	......	508.4	......	...	1.9	......	...	510.3	388.1	1.4	389.5	120.8	23.7

* Full information not available.
† Amounts in bins and driveway not shown separately by records.

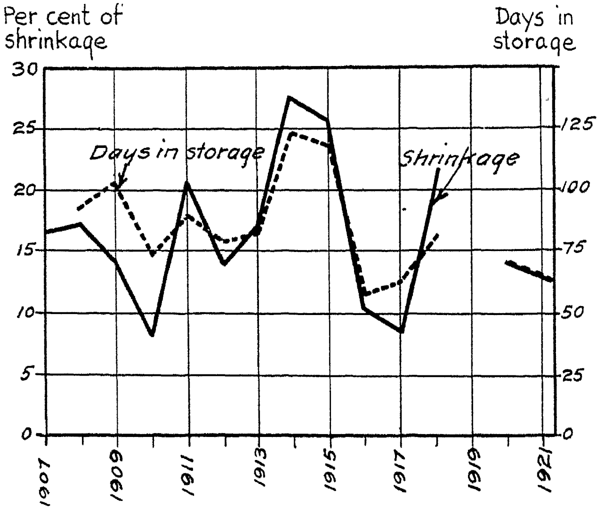


FIGURE 18. SHRINKAGE OF CABBAGE IN PERCENTAGE OF AMOUNT STORED, AND NUMBER OF DAYS IN STORAGE IN THE LITTLE YORK STOREHOUSE

(Data for 1919 not available)

difficult it is to properly regulate the ventilation in storehouses, and therefore the greater is the evaporation or the loss from decay.

The shrinkage in percentage of the amount stored each year, and the number of days that cabbage was in storage at Little York each year, are shown in figure 18. The close relation of the number of days in storage, to the shrinkage, is there shown. Since the temperature is usually low enough to prevent serious loss, and since extreme care is exercised in selecting cabbage which is free from disease to put into storage, the amount of shrinkage depends chiefly on the number of days in storage. In dry years the heads are smaller, and therefore of better size for storing since the shrinkage is less on small than on large heads. Besides the loss in tonnage, the cost is increased by higher labor charges when the shrinkage is heavier.

For the fourteen years from 1908 to 1921, inclusive, an average of 67.2 per cent of the cabbage put into the storehouse was put in during October and the remainder in November (table 34.) In years of low October

TABLE 34. RELATION OF OCTOBER PRICES TO PROPORTION OF CROP PUT INTO STORAGE IN NOVEMBER

October price per ton	Number of years	Per cent of tons put into storage in	
		October	November
Less than $10	7	59.5	40.5
From $10 to $20	3	84.2	15.8
More than $20	4	68.4	31.6
Average	14	67.2	32.8

prices, however, more of the crop was stored in November. When the crop is plentiful and cheap, the price is not likely to rise in November and dealers delay in filling the storehouses. When the crop is scarce and the price high, it frequently happens that there is also more diseased stock,

and, in order to be sure of having sound stock for storing, the houses are filled earlier. In the seven years when the October price per ton was $10 or more, 76 per cent of the amount put in storage was stored in October; and in the seven years when the October price per ton was less than $10, 59 per cent of the amount stored was put in the houses during October. The farmers are not eager to sell when low prices for cabbage prevail, but in years of a small crop and a relatively high opening price they are anxious to sell lest a break should come.

In years when the crop is backward, the tendency is to delay harvesting as long as possible and so obtain greater weight. If unexpected heavy freezes come early in the fall, the result is poor, sour cabbage, which when placed on the market depresses the demand and forces consumers to choose other green vegetables. This prevents the price from rising as high as it otherwise might in short crop years.

The average size of 17,677 wagonloads of cabbage delivered by farmers, by months, during the twenty-eight years from 1894 to 1921, was 3117 pounds net (table 35). The loads delivered in September averaged 122 pounds lighter than those delivered in October, chiefly because the September cabbage was domestic, which is bulkier than Danish. The average size of load decreased as the marketing season advanced, mainly because of road and temperature conditions. This indicates that the cost of delivery from farm to shipping point increases as the marketing season advances.

TABLE 35. AVERAGE SIZE OF WAGONLOADS OF CABBAGE DELIVERED BY FARMERS, BY MONTHS, AT LITTLE YORK, FROM 1894 TO 1921

	Number of loads	Average pounds of cabbage per load
September	828	3,565
October	5,677	3,687
November	3,678	3,399
December	1,402	2,648
January	2,980	2,571
February	1,755	2,439
March	1,013	2,278
April	335	2,178
May	9	1,667
Total and average	17,677	3,117

The better roads, larger horses, modern methods of loading, equipment for hauling large loads, and less inducement to make frequent trips to town, which exist now, mean that loads larger than former loads are now hauled. The handling of cabbage in adjacent villages, which makes the average distance hauled less than formerly, also results in larger loads. In addition, labor was cheaper in the earlier years and farmers were more inclined to play with the market by spreading out their deliveries.

The average length of time that cabbage was in storage thruout a thirteen-years period was 84 days, the range being from 62 days for the

season of 1917 to 124 days for the season of 1914, for shrewd business men unload when they have a favorable opportunity. In 1914, prices did not increase sufficiently to show advantage until April, and in 1917 a substantial increase in January and February was followed by a ruinous decline in March for old white stock. The relation of the average monthly increase in wholesale prices in New York City to the number of days that cabbage was left in storage at Little York, is shown in table 36:

TABLE 36. AVERAGE MONTHLY INCREASE IN NOVEMBER-TO-APRIL WHOLESALE PRICES FOR DANISH CABBAGE IN NEW YORK CITY, AND AVERAGE NUMBER OF DAYS THAT CABBAGE WAS IN STORAGE AT LITTLE YORK

Year	Average monthly increase in New York wholesale prices per ton	Average days cabbage was in storage
1908	$ 5.03*	93
1909	3.68	104
1910	0.00	74
1911	7.71	89
1912	0.21	79
1913	0.96	82
1914	4.07	124
1915	1.20	118
1916	27.79†	57
1917	−0.42	62
1918	18.80	81
1919	....	......‡
1920	1.02	70
1921	0.22*	64
Simple average	$5.41	84

* April not included.
† March and April not included.
‡ Information not available.

The monthly shipments of cabbage out of storage at Little York for fourteen years are shown in tables 37 and 38. The bulk of the storage stock is shipped in December and January. In years when the demand is great, the price is advancing fast, and the southern crop is light, the tendency is to hold more cabbage until February. For the fourteen years shown in table 37, less than 1 per cent of the amount stored in the house referred to was removed in November, 31.8 per cent in December, 34.9 per cent in January, 22.5 per cent in February, 9.7 per cent in March, and 0.2 per cent in April. Thus two-thirds of the storage stock was removed in December and January, and about one-fifth in February. Of the shipments of white cabbage from ground storage for a period of seven years, 27.8 per cent was in December, 45.8 per cent in January, and 21.3 per cent in February.

When cabbage is stored on the ground, opening the bed is likely to introduce frost, and so beds are not opened as early as are houses. When

TABLE 37. MONTHLY SHIPMENTS OF WHITE CABBAGE FROM THE LITTLE YORK STOREHOUSE

Year	Tons of white cabbage						
	November	December	January	February	March	April	Total
1907	....	79.0	41.3	228 0	....	....	348.3
1908	....	77.7	155.4	71.3	34.1	13.0	351.5
1909	....	30.1	33.8	263.1	43.2	....	370.2
1910	....	173.0	162 0	80.2	21.4	....	436.6
1911	....	164.3	160.6	16 4	44.7	....	386.0
1912	11.8	122.0	233.6	80 1	....	....	447.5
1913	....	115.3	226 0	77.9	....	....	419.2
1914	....	76.8	4.5	106 2	205.3	....	392.8
1915	....	....	19.1	127.1	177.9	....	324.1
1916	....	207.5	123 0	....	....	....	330 5
1917	....	77.8	208.5	33.0	....	....	319.3
1918	....	131.1	215.9	59.4	....	....	406.4
1919*	....	....	....	....	....	....	....
1920	....	147.0	204.0	85.5	....	....	436.5
1921	36.7	330.0	115.3	....	....	....	482.0
Total	48.5	1,731.6	1,903.0	1,228 2	526.6	13.0	5,450.9
Per cent each month	0.9	31.8	34.9	22.5	9.7	0.2	100.0

* Information not available.

the beds are opened, the cabbage is usually taken up with more regularity than is that from a house. The large amounts in a house necessitate beginning the taking-out process before the market is strongest, so that the crop may be removed in time for the best average market.

TABLE 38. MONTHLY SHIPMENTS OF GROUND-STORAGE CABBAGE FROM LITTLE YORK

Year	Tons of white cabbage						Tons of red cabbage		
	December	January	February	March	April	Total	December	January	Total
1906	75.6	228.9	24.2	......	59 4	388.1	......	1.4	1.4
1907	11.3	......	......	......	......	11.3	......	......	......
1909	13.4	170.6	......	......	......	184.0	11.7	......	11.7
1910	35.5	......	......	......	......	35.5	......	......	......
1911	112.8	......	......	......	......	112.8	2.6	......	2.6
1912	71.8	......	......	......	......	71.8	......	......	......
1914	......	129.6	221.6	......	......	351.2	......	1.7	1.7
Total	320.4	529.1	245.8	......	59.4	1,154.7	14.3	3.1	17.4
Per cent each month	27.8	45.8	21.3	......	5.1	100.0	82.2	17.8	100.0

In some years, frosty weather interferes with filling the storehouses by making it necessary for the dealers to refuse to store the cabbage until the heads have thawed out, for frosted cabbage should not be put into storage. The long-stemmed, round-headed strains of Danish, or late, cabbage are best for storing. This cabbage is firm, and is not at its best till blanched and ready to crack. It is then crisper, lighter in color, and more tender, much the same as a winter apple. However, the tendency to cross has been so great, that a short-stemmed cabbage, too flat and too large for No. 1 Danish, is more commonly used. Some persons experienced in storing consider that storages are not carrying thru the season with as little shrinkage as formerly, for this reason.

Storing on the ground has the following disadvantages: (1) the labor expense is higher, (2) the shrinkage is greater, and (3) the cabbage frequently cannot be shipped when the market is at its best because the weather conditions which make it difficult to take up cabbage from the ground cause the decreased shipments, and consequently the good market. Frozen cabbage taken up from the ground must be thawed out before shipping. On dairy farms this is usually done by hauling the cabbage into the cow barn where it is warm, and leaving it for one or two days till it thaws out.

The loss of cabbage stored on the ground depends on the weather conditions, the protection provided, and the length of time it is left in storage. A heavy blanket of snow, or thawing weather, will draw the frost out of cabbage stored on the ground. In January, thawing weather in the daytime is frequently followed by heavy freezing at night. This makes the cabbage slippery, so that a large amount of trimming is necessary before shipping.

If cabbage freezes too severely before it is harvested, or if it freezes completely thru the overlapping leaves to the center, the heads develop what is sometimes called " red heart " or " black heart." This is characterized by a soft, watery, dark-colored, decayed, center part, which of course makes the head worthless. Such heads can be identified by the darkened center of the stump, and care should be taken that they are not shipped, as the market for a whole carload may be ruined by a few such heads.

In the early years the heads put into each car of cabbage were counted. From the records of carload weights and the number of heads, the average weight per head was found to be 6.5 pounds for more than 1,000,000 heads, making 308 heads to a ton (table 39). The heads coming out of storage in December weighed about a pound less than the heads purchased in October,

TABLE 39. AVERAGE WEIGHT OF CABBAGE, BY MONTHS, AT LITTLE YORK, FOR THE EIGHT YEARS FROM 1894 TO 1901

	Number of heads included	Average weight per head, in pounds
September	75,036	6.5
October	276,995	7.3
November	351,463	6.8
December	197,055	6.3
January	136,322	5.0
February	38,456	4.8
Total and average	1,075,327	6.5

and those purchased in January and February weighed more than two pounds less. This gives an approximation of the shrinkage in the earlier years, before storehouses were used.

The weights in this table are slightly higher than they actually were per head, because of the practice of counting as one head only those that weighed above 5 pounds. A head lighter than this was considered as

half a head. Counting of the heads was necessary prior to 1900 because New York City quotations were on the basis of 100 heads. The average weight of cabbage delivered in October varied from 6.2 to 8.8 pounds per head, as shown by the records (table 40).

TABLE 40. AVERAGE WEIGHT OF CABBAGE PER HEAD IN OCTOBER, FOR THE EIGHT YEARS FROM 1894 TO 1901

Year	Number of heads	Pounds per head
1894	89,865	7.2
1895	46,485	8.8
1896	23,279	6.6
1897	39,235	7.0
1898	31,210	7.4
1899	28,471	6.2
1900	12,700	6.6
1901	5,750	6.9

The heavy weights in the early years are due to the extensive use of the domestic type of cabbage, and to the low prices, which encouraged a greater insistence on " two heads for one " when the heads were small. From 1899 to 1901, more of the smaller-growing Danish was grown and the prices were higher.

The storehouse at Little York is located 1.5 rods from the loading switch. Data as to size of the wagonloads, when the cabbage was hauled from the house to the car, were obtained (table 41). The loads were lighter in severe weather than in early or late winter.

TABLE 41. AVERAGE SIZE OF WAGONLOADS OF CABBAGE HAULED FROM THE STOREHOUSE AT LITTLE YORK TO CARS, FOR THE SIXTEEN YEARS FROM 1906 TO 1921

	Number of wagon-loads included	Average pounds of cabbage per load
November	22	4,455
December	1,085	3,505
January	1,295	3,395
February	872	2,951
March	297	3,546
April	43	3,367
Total and average	3,614	3,340

The direct labor charges in removing cabbage from storage at Little York are given in table 42. The average for ten years for which records are available was $1.27 per ton. This labor does not include the labor involved in placing the cabbage in storage, for which no detailed information is available as this was done on a commission basis. The average commission for storing in the nine years from 1913 to 1921, inclusive, was

TABLE 42. DIRECT LABOR COSTS OF REMOVING CABBAGE FROM STORAGE AT LITTLE YORK

Year	Man labor		Man and team labor		Tons shipped from storage	Direct labor cost, per ton shipped
	Hours	Cost	Hours	Cost		
1908	1,676	$267.80	236	$ 70.80	364.1	$0.93
1912	1,953	341.77	260	78.00	523.5	0.80
1913	2,175	380.63	260	78.00	424.2	1.08
1914	4,688	820.40	485	145.50	748.1	1.29
1915	1,949	341.07	263	78.90	324.1	1.30
1916	1,564	312.80	210	84.00	347.6	1.14
1917	1,168	292.00	236	94.40	319.3	1.21
1918	2,364	709.20	295	147.50	412.6	2.08
1920	1,733.5	520.05	215	107.50	440 9	1.42
1921	1,944	583.20	220	110 00	484.9	1.43
Average per ton	4.8	$1.04	0.6	$0.23	....	$1.27

89 cents per ton for 4348 tons. The filling of a storehouse provides fairly steady work while it is in progress, and so it is safe for a loader to fill a house on a commission basis. But removing the cabbage is likely to be less regular, requiring possibly many hands one day and few for succeeding days, depending on the way the cabbage is sold. The loader does not care to assume this uncertainty, with its consequent varying cost; therefore the cost of labor in removing cabbage from a house operated by an owner in absentia is usually paid for by the owner.

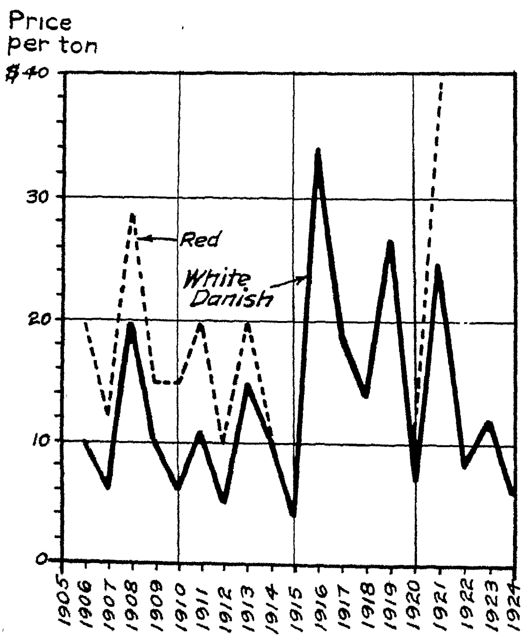


FIGURE 19. PRICES PAID TO GROWERS AT LITTLE YORK FOR WHITE DANISH AND RED CABBAGE PUT INTO STORAGE

For the seasons 1909 to 1914, inclusive, excepting 1913 when the record was not available, a total of 966 tons of cabbage was stored on the ground by Mr. Salisbury. To cover this cabbage a total of 98,050 pounds of hay was used, costing $543.24; or 102 pounds, costing 56 cents, per ton stored.

The average prices paid at Little York to farmers

for Danish cabbage that was put into storage from 1906 to 1921 ranged from $3.94 to $34 (figure 19). Small amounts of red cabbage were stored, and the range in price was from $10 to $40.63 per ton. In late years practically no red cabbage has been stored, the tendency being to grow less of this variety since the larger price for which it sells is not sufficient to justify its much lower yield as compared with that of white cabbage.

Some idea of the large amount of cash or credit necessary to finance a storehouse of cabbage from harvesting time until it is sold, may be gained from table 43. Cash is usually paid to growers.

TABLE 43. PRICES PAID TO FARMERS FOR CABBAGE PUT INTO HOUSE STORAGE AT LITTLE YORK

Year	Danish cabbage			Red cabbage		
	Tons stored	Amount paid to farmers	Average price per ton	Tons stored	Amount paid to farmers	Average price per ton
1921	553.2	$14,081	$25.45	3.3	$130	$39.39
1920	508.9	3,562	7.00	4.6	55	11.96
1919	471.3	12,511	26.55	....	....	....
1918	515.5	7,256	14.08	7.7	307	39.87
1917	347.7	6,708	19.29	....	....	....
1916	368.4	12,526	34.00	19.1	776	40.63
1915	437.6	1,724	3.94	....	....	....
1914	542.0	5,420	10.00	3.8	38	10.00
1913	504.7	7,595	15.05	6.8	136	20.00
1912	519.5	2,346	4.52	5.7	57	10.00
1911	483.3	5,218	10.80	20.7	414	20.00
1910	476.2	2,633	5.57	28.1	421	14.98
1909	417.4	4,090	9.80	55.5	832	14.99
1908	423.3	8,310	19.63	16.0	469	29.31
1907	375.9	2,255	6.00	45.5	545	11.98

Very little difference is noted between October and November prices paid for storage stock at Little York thruout fourteen years (table 44). The November price for thirteen years averaged $15.26, or only 44 cents per ton lower than the October price. The size of the crop largely determines the price, which usually remains steady for the two months altho it is more likely to drop, as harvesting advances, than it is to rise.

TABLE 44. AVERAGE MONTHLY PRICES PAID FOR CABBAGE STORED AT LITTLE YORK

Year	Danish cabbage			Red cabbage	
	October	November	December	October	November
1908	$19.92	$18.76	$24.00	$29.85	$29.09
1909	9.89	9.59	....	14.93	15.00
1910	5.23	5.81	....	15.00	15.04
1911	10.77	10.99	....	20.10	....
1912	4.59	4.12	....	10.00	10.00
1913	15.05	15.02	....	20.00	....
1914	10.00	10.00	....	10.00	....

TABLE 44 (*concluded*)

Year	Danish cabbage			Red cabbage	
	October	November	December	October	November
1915	$ 4 00	$ 3.91	....	....	....
1916	32.53	35.48	....	$39.74	$43.00
1917	25.96	19.19	....	....	....
1918	14.09	13.95	....	40.45	40.31
1919	26.56	26 24	....	....	....
1920	....	7.00	....	....	12.22
1921	25.45	25.29	....	39.70	....
Average*	$15.70	$15.26	....	....	....

* Average for thirteen years, 1920 being omitted.

In years of low November prices, farmers hold more of their cabbage until after December 1 than they do in years of high November prices (table 45); and in years of light rainfall, which means relatively light

TABLE 45. RELATION OF NOVEMBER PRICE OF CABBAGE TO GROWERS AT LITTLE YORK, TO PROPORTION OF CROP SOLD BY FARMERS BEFORE DECEMBER 1, FOR THE TWENTY-EIGHT YEARS FROM 1894 TO 1921, INCLUSIVE

November price to growers		Number of years	Per cent of season's purchases of cabbage at Little York, before December 1*
Range	Average		
Less than $8	$ 4 53	14	62†
From $8 to $12	9.96	7	67
More than $12	22.45	7	75

* The monthly purchases of the principal shipper of cabbage at Little York are here taken to express the relation of the fall price to the holding practices of producers.
† If the five years from 1894 to 1898, when chiefly non-storable domestic cabbage was grown before the introduction of Danish, are omitted, the figures for the remaining nine years are: price, $4.99; per cent before December 1, 57.

production, a larger share of the crop is marketed earlier than in years of heavy rainfall, or heavy total production (table 46). But in years of light rainfall, or a relatively short crop, prices from November to March

TABLE 46. RELATION OF RAINFALL IN THE NEW YORK CABBAGE DISTRICT (USED AS AN INDEX OF SIZE OF CROP), TO PROPORTION OF CROP SOLD BY FARMERS AT LITTLE YORK BEFORE DECEMBER 1, FOR THE TWENTY-EIGHT YEARS FROM 1894 TO 1921, INCLUSIVE

Rainfall in New York commercial-cabbage district, in per cent of normal		Number of years	Per cent of season's purchases of cabbage at Little York, before December 1
Range	Average		
Less than 90	81	10	71
From 90 to 110	99	8	66
More than 110	122	10	62

increase 50 per cent more in actual dollars than when the crop is large. In short, opening prices, rather than prices expected later in the season, regulate the movement of this crop from farms.

The thirteen-years average cost of holding cabbage, per ton of cabbage shipped from the storehouse at Little York, is shown in table 47. The average cost of holding, excluding central-office overhead expenses, incidental expenses, depreciation on the storehouse, and cost of selling the

TABLE 47. APPROXIMATE COSTS OF HOLDING CABBAGE AT THE LITTLE YORK STOREHOUSE

Costs	Thirteen-years average, per ton of cabbage shipped from house storage			
	Value per ton	Per cent of total holding charge	Per cent of total amount paid to farmers and storage holding charge	Per cent of total amount paid to farmers, storage holding charge, and transportation
Agent's commission for buying and putting cabbage into storehouse*	$0 92	14 4	4 6	3.9
Interest:†				
On cabbage, at 6 per cent for 84 days ($6548)	0.22	3.5	1.1	0.9
On $7000 property, at 5.5 per cent for one year	0.96	15.1	4.8	4.1
Taxes and insurance on storehouse	0 23	3.6	1.2	1.0
Insurance on cabbage	0.11	1.7	0 5	0.5
Direct labor in removing cabbage from storage‡	1 27	19.9	6.4	5.4
Shrinkage and loss, 16.4 per cent of first cost of cabbage ($13.58 per ton)	2.66	41.8	13.3	11.2
Total of above items of storage holding costs§	$ 6.37	100.0	31.9	27.0
Amount paid to farmer for cabbage	13.58	....	68.1	57.4
Total of first cost and preceding holding charges	$19.95	....	100.0	84.4
Average freight rate to New York for years included	3.69	....	....	15.6
Total of amount paid to grower, storage holding charge, and transportation	$23.64	....	....	100.0

* Commissions on stored cabbage from 1908 to 1918 and from 1920 to 1921, inclusive, a total of 5239 tons shipped from house storage.

† Interest on 403 tons of cabbage costing $6548, an average for the years from 1908 to 1918 and from 1920 to 1921, inclusive. The value of the property is estimated.

‡ Direct labor includes man labor and man and team labor in removing cabbage from storage during the years 1908, 1912 to 1918 inclusive, and 1920 to 1921 inclusive.

§ These do not include central-office overhead and incidental expenses, or depreciation on storehouse.

cabbage, was $6.37 per ton. Of this total, the agent's commission for buying and putting the cabbage into the storehouse comprises 14 per cent, the interest on the cabbage 3 per cent, the interest on the storehouse property 15 per cent, taxes and insurance on the storehouse 4 per cent, insurance on the cabbage 2 per cent, direct labor in taking cabbage from storage 20 per cent, shrinkage and loss 42 per cent.

The average amount paid to the farmers for cabbage for these thirteen years was $13.58 per ton. Therefore the total of the first cost of the cabbage and the holding charges indicated was $19.95 per ton. Of this, the storage charge was 32 per cent and the price to farmers was 68 per cent. The average freight rate on cabbage to New York City, for the years included, was $3.69 per ton, making the total of the amount paid to the grower, the house-storage holding charge, and the transportation, $23.64 per ton. Of this, the freight was 16 per cent, the holding charge 27 per cent, and the amount paid to the growers 57 per cent.

The charge for fire insurance was computed at a rate of $1.75 per $100 of insurance, on the basis of the standard short-term policies. This calculation gives the percentage retained by the company on policies canceled at various times before the expiration of the year. The amount retained by the insurance company for ninety days is 40 per cent of the annual rate, or 70 cents per $100 of insurance. For sixty days it is 30 per cent, and for one hundred and twenty days 50 per cent.

The variations for nine years in the holding charges, including actual shrinkage, direct labor in removing the cabbage from the storehouse, interest on the cabbage while in storage, commission for storing, insurance on the cabbage while in storage, and interest, taxes, and insurance on the storehouse, are shown in table 48:

TABLE 48. ANNUAL VARIATION IN HOLDING CHARGES FOR NINE YEARS IN STOREHOUSE AT LITTLE YORK

Charge	Per cent of total holding charges								
	1912	1913	1914	1915	1916	1917	1918	1920	1921
Agent's charge for buying and filling house	17.5	9.5	9.3	13.4	13.7	18.5	14.5	31.3	20.5
Interest and insurance on cabbage	3.1	5.8	5.6	3.0	6.8	5.7	4.2	2.6	5.7
Interest, taxes, and insurance on storehouse	32.6	18.3	16.6	30.2	17.3	26.1	13.5	19.9	12.0
Labor in removing cabbage from storehouse and loading on cars	24.1	17.1	17.3	25.9	13.9	20.6	23.7	25.5	17.0
Shrinkage and loss	22.7	49.3	51.2	27.5	48.3	29.1	44.1	20.7	44.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Holding charge per ton sold	$3.32	$6.33	$7.45	$5.01	$8.17	$5.88	$8.77	$5.58	$8.41

The amount paid to the farmers for cabbage, the house-storage holding charges, and the freight charge to New York, equal the cost of placing the cabbage in New York, extra small selling expenses, and central-office expenses not ascertained. This total, for the storehouse at Little York, varied from \$10.89 per ton for cabbage shipped in the season of 1912–13, to \$45.65 per ton for the season of 1916–17.

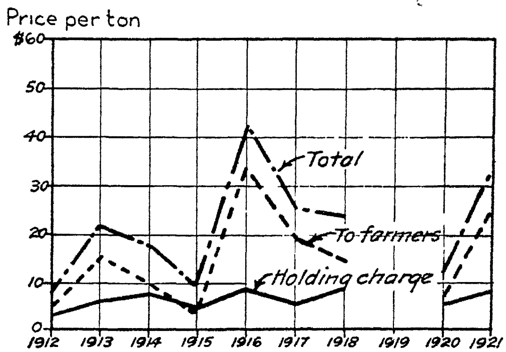


FIGURE 20. ANNUAL VARIATIONS IN THE AMOUNT PAID TO FARMERS AND IN HOLDING CHARGES, FOR STORED CABBAGE AT LITTLE YORK

(Data for the year 1919 not available)

The amount received for this cabbage was not ascertained, but the costs have been compared with the average wholesale prices of white Danish cabbage in New York City in the months during which the cabbage was shipped from the Little York storehouse. The difference between these wholesale city prices and the costs is shown in table 49. This difference ranged from –\$7.74 per ton for the season of 1914–15, to +\$27.18 per ton for the season of 1916–17. The average for nine seasons was \$3.72 per ton. Since most of this cabbage was handled on a joint-account basis, it would appear that the shipper received approximately \$1.86

TABLE 49. AMOUNT PAID TO FARMERS, HOLDING COSTS, FREIGHT CHARGES, AND WHOLESALE PRICES IN NEW YORK CITY

Year	Amount paid to grower, per ton of cabbage sold	Shrinkage and other holding and loading costs, per ton	Freight charge to New York City, per ton	Total cost	Average wholesale price in New York City in months shipped	Difference, per ton
1912....	\$ 4.57	\$3.32	\$3.00	\$10.89	\$ 7.16	–\$ 3.73
1913....	15.11	6.32	3.00	24.43	26.96	+ 2.53
1914....	10.00	7.45	3.00	20.45	12.71	– 7.74
1915....	3.94	5.01	3.16	12.11	12.10	– 0.01
1916....	34.33	8.16	3.16	45.65	72.83	+ 27.18
1917....	19.29	5.89	3.60	28.78	45.18	+ 16.40
1918....	14.46	8.77	4.50	27.73	24.31	– 3.42
1919*...	....	....	....	....	....	....
1920....	7.05	5.58	6.30	18.93	14.30	– 4.63
1921....	25.54	8.41	6.30	40.25	47.16	+ 6.91
Simple average........						\$3.72

* Information not available.

per ton, or about $23 per car, to pay him for his time and to cover his office and selling expenses. The joint-account partner in the city would on this basis likewise receive an equal amount.

The speculative nature of the storing of cabbage is sometimes not sufficiently appreciated, and when the crop is very short and an exceptional gain is made, the many years when losses occurred are forgotten. If farmers desire to store and market their own cabbage crop they must be willing to engage in the enterprise with the expectation that the chances are good that in many years they will lose, and lose heavily, and therefore that in order to be successful they must continue with the business for a sufficient number of years to make it worth while. When all things are considered, the business of holding cabbage is no royal road to easy wealth. It is only one of the many kinds of business activities which allow a living wage. If one is not in a financial position to continue in the business after a year of heavy loss, it offers a good opportunity to lose considerable money.

TABLE 50. MONTHLY SHIPMENTS OF WHITE CABBAGE BY F. N. SALISBURY, FROM LITTLE YORK

Year	Tons of cabbage									
	September	October	November	December	January	February	March	April	May	Total
1894	.....	322.0	246.5	412.7	141.0	59.3	.....	.....	.....	1,181.5
1895	.....	203.8	352.9	140.8	.....	.....	.....	.....	.....	697.5
1896	.....	77.3	257.2	66.4	83.8	78.5	27.7	.....	.....	590.9
1897	12.6	137.9	138.7	14.6	181.2	.....	.....	.....	.....	485.0
1898	98.5	115.6	181.3	.....	.....	.....	.....	.....	.....	395.4
1899	.....	162.5	227.0	14.8	45.8	42.5	.....	.....	.....	492.6
1900	25.0	97.9	120.3	.....	218.6	240.4	.....	.....	.....	702.2
1901	174.7	224.4	250.6	205.7	368.0	107.6	128.3	.....	.....	1,459.3
1902	12.1	71.4	46.8	39.1	80.7	69.9	13.0	96.6	.....	429.6
1903	.....	137.8	29.7	66.7	127.5	.....	.....	.....	.....	361.7
1904	13.3	102.1	.....	13.4	87.6	69.9	61.9	57.9	.....	406.1
1905	87.0	158.7	208.7	77.2	104.8	82.4	51.8	11.4	.....	782.0
1906	162.2	391.7	140.1	103.4	354.5	126.7	28.1	87.3	7.5	1,401.5
1907	53.0	178.1	36.4	107.7	198.5	287.9	50.0	.....	.....	911.6
1908	43.5	37.8	.....	141.7	288.8	123.0	34.1	24.4	.....	693.3
1909	115.3	250.8	52.6	150.6	452.9	339.2	53.5	9.8	.....	1,424.7
1910	92.8	483.7	96.2	396.0	636.1	359.4	225.3	27.9	.....	2,317.4
1911	39.5	264.7	65.5	297.8	445.3	238.9	73.6	.....	.....	1,425.3
1912	67.7	396.4	160.5	220.2	263.3	92.1	13.5	.....	.....	1,213.7
1913	24.2	169.0	62.5	227.4	424.9	163.3	124.2	48.5	.....	1,244.0
1914	85.4	67.6	26.5	103.3	357.8	499.0	299.8	.....	.....	1,439.4
1915	.....	104.2	103.7	12.9	87.3	184.0	321.1	57.5	.....	870.7
1916	39.4	199.0	.....	257.8	153.5	11.8	.....	.....	.....	661.5
1917	50.7	429.2	103.0	206.8	521.2	190.8	75.9	15.9	.....	1,593.5
1918	169.8	324.2	57.3	169.5	363.4	104.6	57.4	.....	.....	1,246.2
1919	25.4	221.6	61.9	49.7	43.7	.....	.....	.....	.....	402.3
1920	.....	74.1	368.5	161.2	233.8	139.9	36.3	.....	.....	1,013.8
1921	83.7	211.4	88.9	330.0	164.9	61.7	11.8	.....	.....	952.4
Total	1,475.8	5,614.9	3,483.3	3,987.4	6,428.9	3,672.8	1,687.3	437.2	7.5	26,795.1
Per cent	5.5	21.0	13.0	14.9	24.0	13.7	6.3	1.6	.....	100.0

During the twenty-eight years from 1894 to 1921, Mr. Salisbury looked after the shipping of about 27,000 tons of white cabbage, most of which was Danish. Of these shipments, 5 per cent were made in September, 21 per cent in October, 13 per cent in November, 15 per cent in December, 24 per cent in January, 14 per cent in February, 6 per cent in March, and 2 per cent in April (table 50). A comparison of the monthly distribution of these shipments for twenty-eight years, with the monthly purchases, is shown in figure 21.

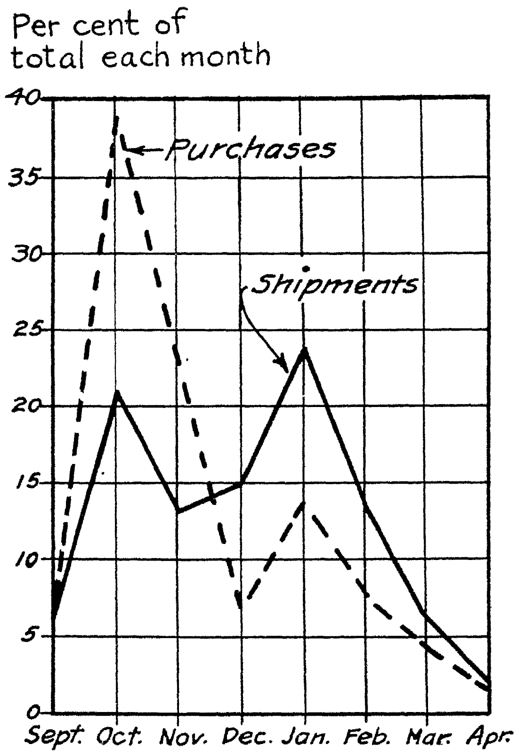


FIGURE 21. COMPARISON OF PURCHASES AND OF SHIPMENTS, BY F. N. SALISBURY AS LOADING AGENT, FOR TWENTY-EIGHT YEARS AT LITTLE YORK

A comparison of the monthly average of shipments of cabbage from Little York for twenty-eight years by Mr. Salisbury as loading agent, with the average of shipments originating in New York State during the seven years from 1917 to 1923, and with the six-years average of unloads in New York City originating in the State, is given in table 51 and in figure 22. The chief difference shown here is that Little York shipments

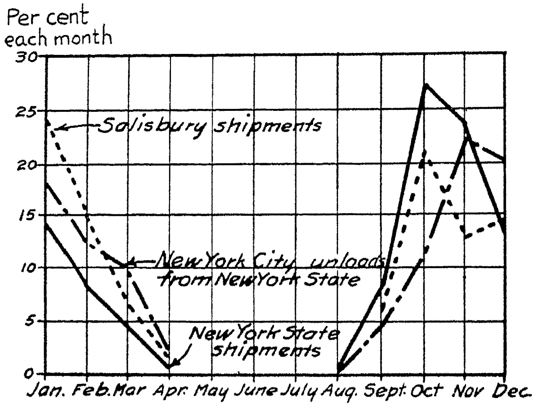


FIGURE 22. COMPARISON OF SHIPMENTS BY F. N. SALISBURY AS LOADING AGENT, WITH SHIPMENTS FROM NEW YORK STATE AND WITH UNLOADS IN NEW YORK CITY ORIGINATING IN THE STATE

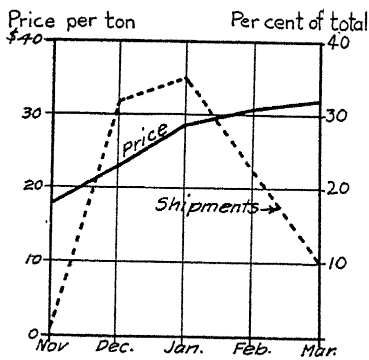


FIGURE 23. AVERAGE OF WHOLESALE PRICES OF CABBAGE IN NEW YORK CITY FOR FOURTEEN YEARS (1907 TO 1921, EXCEPT 1919), AND AVERAGE MONTHLY MOVEMENT OF THE CROP FROM THE LITTLE YORK STOREHOUSE

were less in the fall and more from December to the end of the season, than were the general run of shipments for the State for the years used, because a larger proportion of the total amount shipped was stored. Also, the shipments from Little York were relatively more in October than the unloads in New York City because of the earlier harvesting season in Cortland County.

TABLE 51. SEASONAL VARIATION IN CAR-LOT UNLOADS OF CABBAGE IN NEW YORK CITY, ORIGINATING IN NEW YORK AND ON LONG ISLAND, AND IN SHIPMENTS FROM LITTLE YORK BY F. N. SALISBURY

Month	Unloads in New York City originating in New York State, from 1918 to 1923	Shipments from Little York by F. N. Salisbury, from 1894 to 1921
	Per cent of total	Per cent of total
January	18.0	24.0
February	12.2	13.7
March	9.6	6.3
April	1.7	1.6
May	......	......
June	......	......
July	......	......
August	0.4	......
September	4.7	5.5
October	11.0	21.0
November	22 2	13.0
December	20 2	14 9
Total for year	100.0	100.0

Less than one-half of the cabbage stored at Little York was shipped to New York as its primary destination. Boston, Pittsburgh, Philadelphia, and Baltimore were the next largest receivers of this stored cabbage, and the remainder was scattered to many destinations (table 52).

TABLE 52. DESTINATION OF CARLOADS OF CABBAGE SHIPPED FROM STORAGE AT LITTLE YORK, FROM 1905 TO 1921

Primary destination	November	December	January	February	March	April	May	Total
Baltimore, Maryland	......	4	11	13	3	......	......	31
Richmond, Virginia	......	4	9	8	1	......	....	22
New York, New York	......	4	11	10	......	......	......	25
Hoboken	......	14	22	15	8	......	......	59
Harlem Terminal and The Bronx	4	41	34	15	1	3	......	98
Brooklyn Terminal and Wallabout	3	33	39	15	1	......	......	91
Paterson, New Jersey	......	2	4	6	1	......	......	13
Jersey City, New Jersey	......	4	3	2	......	......	......	9
Pittsburgh, Pennsylvania	......	8	22	10	5	......	......	45
Philadelphia, Pennsylvania	......	8	12	7	8	......	......	35
Boston, Massachusetts	......	11	29	23	16	......	......	79
Destinations not reported	4	19	13	7	6	4	......	53
All others	......	40	33	15	8	......	......	96
Total	11	192	242	146	58	7	......	656

The destination of unstored cabbage that was shipped by Mr. Salisbury since 1894 is shown in table 53. New York, Baltimore, and Philadelphia were the leading primary destinations. Many of the car lots for which a destination was not reported were sent to New York.

TABLE 53. DESTINATION OF CARLOADS OF UNSTORED CABBAGE SHIPPED BY ONE LOADING AGENT AT LITTLE YORK

Primary destination	September	October	November	December	January	February	March	April	May	Total
New York, New York	7	15	3	6	15	10	1	2		59
Hoboken	13	77	19	19	42	28	18	4	.	220
Harlem Terminal	13	34	16	15	20	14	5	5	...	122
Wallabout	8	28	14	5	17	16	7	...	.....	95
The Bronx	3	15	16	11	25	9	1	.	.....	80
Brooklyn Terminal	1	15	6	8	13	6	1	1	...	51
Baltimore, Maryland	23	74	58	30	31	18	6	..	...	240
Philadelphia, Pennsylvania	15	16	7	8	31	4	9	2	......	92
Richmond, Virginia	.....	12	11	5	15	7	1	...	...	51
Pittsburgh, Pennsylvania	1	11	3	6	13	6	3	....	.	43
Washington, D. C.	1	5	3	4	4	......	...	.....	....	17
Columbus, Ohio	..	2	3	3	2	3	1	....	...	14
Paterson, New Jersey	...	.....	....	2	3	3	2	1		11
Cleveland, Ohio	....	.....	3	4	..	1	2	.	..	10
Jersey City, New Jersey	2	10	2	2	6	4	...	....	...	26
Charlotte, North Carolina	......	3	2	1	6	3	....	...	.	15
Louisville, Kentucky	.....	2	....	1	6	2	3	.	...	14
Destinations not reported	20	38	22	15	34	25	17	12	1	184
All others	5	52	42	27	55	20	27	5	...	233
Total	112	409	230	172	338	179	104	32	1	1,577

CABBAGE STOREHOUSES IN THE STATE

A questionnaire was mailed to several county agents in order to find how many storehouses for cabbage were being operated in each county. This was followed by another questionnaire, sent to each owner of a storehouse in order to ascertain the capacity of, and the amounts stored in, his house during the past six years. The locations of the various storehouses are shown in table 54:

TABLE 54. FIRMS OR INDIVIDUALS WHO WERE KNOWN TO HAVE CABBAGE STOREHOUSES IN NEW YORK STATE IN 1923, AND WHO REPLIED TO A QUESTIONNAIRE FROM THE NEW YORK STATE COLLEGE OF AGRICULTURE

County	Firm or individual	Location of storehouses	Post-office address
Cayuga	Bowen, Mason	Basement of barn	Sennett
	Donovan, Dennis	Center Street Road, Sennett	Auburn, R.D. 7
	Nash Bros.	Sennett	Sennett
	Smith, Bert	Adjoining basement of cow barn	Locke
Chemung	Roberts, E. M.	455 E. Clinton Street	Elmira
Chenango	Paddleford, J. F.	Smyrna, Randallsville, and Sherburne	Sherburne
	Shepardson, J. W.	Smyrna	Smyrna
Cortland	Button, Ira	Scott Road, Homer	Homer
	Frey Co., John B.	Little York	Little York
	Hilton, F. L.	Truxton	Truxton
	Litz, H. A.	Homer	Homer
	Mourin & Merrill	Main Street, Homer	Homer
	Miller, P. J.	Preble	Preble
	Rofe, E.B., and others	Near depot, Preble	Preble
	Wavle, Chaplin, & Fitts	Homer (Cortland Co.) and McLean (Tompkins Co.)	Homer
Erie	Ayers, G. F.	Crittenden	Crittenden
Genesee	Hickox-Rumsey Co.	Ellicott Street, Batavia	Batavia
Livingston	Bailey, H.	South Lima, one-half mile from railroad station	South Lima
	Chamberlin, L. H.	South Livonia	Livonia
	Giles, Elroy	Near Wadsworth	Scottsville
	Prettjohn, Theo.	Erie Railroad switch	Livonia
Monroe	Blossom, J. E., & Son	On farm	Walker
	Brockport Fruit Assn.	Brockport	Brockport
	Buyck Bros.	Henrietta	Henrietta
	Calkins, J. N.	Henrietta, Rush, Rochester Junction	Henrietta
	Chase, B. K.	Henrietta	Henrietta
	Clapper, Philo	Hilton	Hilton
	Dailey Produce Co.	Brockport	Brockport
	Darrohn, E. G.	West Henrietta	Scottsville
	Decker & Calkins	Rush	Rush
	Diver, Chas. M.	West Henrietta	West Henrietta
	Dunn, Fred L.	Mendon	Mendon
	Fehr, Frank, & Son	Webster	Webster
	Green, E. H.	Rush	Rush
	Hetzlo, George	Rush	Rush
	Hilton Milling & Warehouse Co.	Hilton	Hilton
	Hosenfeld, Geo. H.	Webster	Webster
	Howland, Norton	Henrietta	Henrietta

TABLE 54 (*concluded*)

County	Firm or individual	Location of storehouses	Post-office address
Monroe	Mason, Russell B.	Webster	Webster
	Miller, Joe	Morton	Morton
	Moore, Stanley	Hilton	Hilton
	Morton Land Corp.	Morton	Morton
	Naber, Joseph	Jefferson Road, Pittsford	Pittsford
	Nelson, Guy	Between Brockport and Bergen	Brockport
	Newman, F. W.	Hamlin	Hamlin
	Newton, Mark C.	Henrietta	Henrietta
	Perry, John H.	Henrietta	Henrietta
	Roberts & Newcomb	Hilton	Hilton
	Schoen, Geo. C.	Pittsford	Pittsford
	Smith, Geo. G.	Pittsford	Pittsford
	Stone Bros.	Henrietta	Henrietta
	Tapley, C. S., Co.	Brockport	Brockport
	VanVorhis, Henry	Henrietta	Henrietta
	VanVorhis, Herman	Pittsford	Pittsford
Oneida	Stellwagen, Charles.	Verona	Verona
	Wilson Bros.	Blackmans Corners	Verona
	Wilson, S. E. and F. S.	On Rome and Oneida road	Rome
Onondaga	Dorthey, S. F., and Jill Bros.	Apulia Station	Apulia Station
Ontario	Court & Noble	Seneca Castle	Seneca Castle
	Dixon Bros.	Hall	Hall
	Lynch, John J.	Two miles east of Seneca Castle	Stanley
	Maney, J. R., & Bro.	Seneca Castle	Seneca Castle
	Pennington Black Co., Inc.	Orleans	Seneca Castle
	Smith, E. G., and others	Flint	Stanley
	Soper, Harold G.	On farm	Geneva
	Webster, E. L.	On farm 5 miles west of Geneva	Stanley
Orleans	Beckwith, Dwight S.	North side New York Central Railroad	Albion
	Burnett, M. A.	100 rods from railroad or market	Kendall
	Carlton Produce Co., Inc.	Carlton	Carlton
	Carr, James H.	On farm	Kent
	Haight, Arthur E.	West Kendall	West Kendall
	Kendall Produce Co., Inc.	East side of main road	Kendall
	Kent Produce Co., Inc.	Two on east side, one on west side, of highway	Kent
	Miller, Geo	Kendall	West Kendall
	Reynolds & Clark	Kent	Albion
Wayne	Snyder, Judson	Sodus Point	Newark

The ordinary capacity of the 100 houses for which data were obtained was 2124 carloads of cabbage, or 266 tons per house (table 55). At no time during the past five years, however, have the houses been filled. The amount in storage ranged from one-half to two-thirds of the full capacity when the driveways were included.

TABLE 55. INFORMATION CONCERNING CABBAGE STOREHOUSES IN NEW YORK STATE OBTAINED THRU QUESTIONNAIRES SENT OUT BY THE NEW YORK STATE COLLEGE OF AGRICULTURE

County	Number of storehouses from which reports were obtained	Average distance from storehouse to loading switch (feet)	Ordinary capacity, in tons		Tons in storage					
			Total	Average per house	1924	1923	1922	1921	1920	1919
Cayuga	4	15,180	328	82	160	123	175	153	326	200
Chemung	1	....	38	38	......	38	......	......	......	....
Chenango	4	660	1,650	412	90	50	......	600	650	700
Cortland	9	1,792	3,620	402	1,570*	2,595	1,878	3,356	2,381	2,873
Erie	1	....	300	300	150	50	150	250	300	300
Genesee	1	....	450	450	200	153	......	400	400	400
Livingston	6	761	1,140	190	241†	381	507	304	549	181
Monroe	40	4,964	6,126	153	4,696‡	3,359	3,942	3,117	2,526	1,968
Oneida	3	6,160	650	217	185	385	225	160	180	200
Onondaga	4	200	2,000	500	135	1,402	600	1,670	1,600	1,024
Ontario	15	2,880	4,900	327	1,350	3,875	3,564	3,225	2,435	2,595
Orleans	11	1,389	4,550	414	2,674	2,755	3,564	2,916	3,238	2,572
Wayne	1	....	800	800	5,204	400	300	400	......	......
Total	100	....	26,552	.....	16,655	15,566	14,905	16,551	14,585	13,013
Carloads of 12.5 tons	....	....	2,124	..	1,332	1,245	1,192	1,324	1,167	1,041

* Excluding 2 firms with 3 houses reporting 1250 tons in 1923.
† Excluding 1 firm with 2 houses reporting 187 tons in 1923.
‡ Excluding 1 firm with 1 house reporting 260 tons in 1923.

The dimensions of 91 storehouses were obtained. The total content of these houses was 3,674,557 cubic feet, or 40,380 per house. The ordinary capacity of the houses, including the driveways, totaled for the 91 houses 24,254 tons, or 267 per house. Therefore the content was 152 cubic feet per ton of capacity, or 13 pounds of cabbage per cubic foot of capacity. The houses with the largest capacity for storing cabbage are in Monroe, Ontario, Orleans, Cortland, and Onondaga Counties. Future attempts to gather data on house storage of cabbage will, it is hoped, result in a more complete enumeration of cabbage storehouses.

Local cabbage buyers who have storehouses situated by railroad switches have no alternative but to sell out their cabbage in storage. In very large crop years, it sometimes happens that some of them unprofitably hold their cabbage too long. The result is that after vainly offering to sell, then to give, it to the farmers, they finally have to pay some one to haul it out. A farmer with storage facilities on the farm can feed the cabbage to his stock if the market breaks; but if he is joint or full owner of a storehouse in the village, he then assumes the same risk of complete loss as does the produce dealer, because it would hardly pay to haul the cabbage to the storehouse and then back to the farm to be used as feed.

Dealers store about the same tonnage each year, as the data in table 55 show. In large crop years, they frequently stop buying for short periods in the fall when the market is glutted and sometimes they refuse to buy large cabbage, which, of course, becomes smaller after passing the winter on the ground. The effect of this is to force the farmers to store more on their own farms. It would appear that in large crop years the chief difference in the amount held in storage is represented by the amount held by farmers. Also, in such years the dealers are likely to move their holdings out of storage early, because of the anxiety over the effects on price caused by large amounts being held by farmers, and also because they wish to be in a position to handle what the growers have as soon as the growers are ready to move it. This tends to put the burden of extra labor and extra storage costs on the growers when the crop is large.

Mr. H. S. Mills, of the Department of Vegetable Gardening at this College, studied the operation of cabbage storehouses in the winter of 1919–20. He found that the following practices gave the best results:

1. A temperature of about 32° F. should be maintained at all times. In a good house, a fluctuation from 30° to 36° F. may be expected during freezing weather.

2. Bins not more than 3 feet wide and from 5 to 10 feet high should be used when the cabbage is to remain in storage for more than a month.

3. Storage in underground cellars gives the greatest trouble because of the difficulty of keeping such a storage well ventilated.

The following points also should be considered when storing cabbage:

1. Badly diseased cabbage should not be stored, as some diseases multiply in storage and thereby cause much loss.

2. Bruised or spotted outer leaves should be removed, thus reducing the chances of disease infecting the entire head, and reducing also the susceptibility of the cabbage to decay.

3. The interior of the storehouse should be sprayed as soon as the cabbage is taken out, in order to destroy disease spores. From 2 to 4 pounds of copper sulfate in 50 gallons of water is an efficient disinfectant.

4. For plenty of protection, about one ton of hay should be allowed for each ten tons of cabbage. The covering should be spread each day as the cabbage is laid down, to prevent it from getting frosted. Too often the covering is neglected until a heavy freeze comes. The heads then soon become slippery when covered and the loss is increased.

The costs of holding cabbage on a farm without a storehouse are for the following items: the extra labor in unloading and placing the cabbage on the ground; labor in covering the bed; labor in taking up the cabbage, hauling it to a warm place, trimming the heads, and reloading; loss in weight of the cabbage due to cracking, drying, freezing damage from rodents, and decay; cost of material to cover the bed; and extra costs of hauling because, as previously shown, the loads are much smaller, and the condition of the roads less favorable, in winter.

The long-run margin between city wholesale prices, and prices to growers, is based on costs of loading at country points, including labor, paper, demurrage, bulkheads, heat in cold weather, and overhead expenses of produce dealers, transportation costs, expense of unloading and of sacking or barreling in the city, and wages to the country dealer and the city jobber for their time. Shipping cabbage is only a part of the business of country dealers, who handle other produce also and sell feed and supplies. The loading costs under such circumstances are less than they are for persons engaged especially in the business. The farm produce sold is one means of paying feed bills.

When cabbage is held, the advance in price must be sufficient to cover all of these marketing costs besides the extra costs of holding, if the grower or the country produce dealer is not to lose money.

The cooperative ownership of cabbage storehouses is still in an experimental stage. Theoretically the advantage to the producers of having cooperative ownership of a storehouse is that it is possible to assist in equalizing the distribution of the crop; but with the practice of selling at harvest time, it is not possible to receive a reward for such services. The purchase of a site with the advantages of being near a railroad switch, and the construction of a large, well-built, frost-proof storehouse, require considerable capital, and the joint undertaking of such a venture by several farmers enables each to have storage space at a more reasonable investment.

Such ownership, however, involves decisions on which it is not always easy to get partners to agree. As the seasonal course of prices is speculative, some will be optimistic and others pessimistic regarding price situations. With this difference of opinion, some will want to sell early and some will prefer to hold in anticipation of higher prices. Unless the crop is pooled, dissatisfaction is likely to result from the inability of the farmers to get at their own cabbage in the house when they wish, or to get cars. It cannot be expected that the entire contents of the storehouse could be moved at the high price. This means that some of the cabbage must be moved before the price reaches its peak, and some after it has begun to fall. Unless the crop is pooled, the decision as to who is to get the peak price and who is to get less is not easily reached.

In 1920, six farmers at Preble, New York, purchased a storehouse. The experience of these men in the first year of their venture was that they filled the house when dealers were paying from $8 to $10 a ton for

cabbage in the fall. Practically the entire crop was left in the house until spring, and was spread for fertilizer the next year. In 1921, cabbage brought from $28 to $30 a ton out of the field in the fall. The house was filled again. The price reached its peak from January 1 to January 10 at $45 a ton in the locality of this house. Three of the men sold advantageously; the remainder held their crop too long in anticipation of better prices, and lost money. In 1922 the crop was large, and five of the men stored. Some of the space in the storehouse rented for $2 a ton. The price was $8 a ton out of the field, and reached $15 a ton at Christmas time and $40 a ton later in the winter. One of the owners sold for $10 a ton, based on inweights, about three weeks after storing. Another sold at $15, based on inweights, about five weeks after storing. The remaining three sold later in the winter at various times at from $10 to $40 a ton. The house has thus been a financial loss to these farmers in one year out of three.

The best location for a cooperative storehouse is on a railroad switch, because of the advantages resulting when the crop is removed from the house. In most years of an extremely large Danish crop, however, the house had better be used for other purposes, left empty, or rented to some one who desires to store; but in most years it will pay to fill the house. Therefore a location favoring economy in getting the cabbage where it can be fed or spread in the fields, is not so important as a location favoring economy in loading railroad cars.

PRICES PAID TO PRODUCERS FOR CABBAGE AT LITTLE YORK

MONTHLY PRICES

Much speculative anticipation prevails among producers and dealers every fall as to what will be the shipping-point winter prices for cabbage.

With all fairness it can be said that very few growers have opinions of what the price should be, based on knowledge of the condition or size of the crops. Some country buyers form careful opinions from the facts, and some know practically nothing about the price prospects. Price-making to the producer begins at the city, where the supply of cabbage and other green vegetables establishes a general level of price for this kind of produce. From this the country shipper determines what he can pay the grower and still make his profit. This being the case, the dissemination of information as to what establishes the city price may help some one to realize more for his crop. Some of the influencing factors to be considered at any time are: (1) the size of the country's crop; (2) the extent of the fall movements of the crop; (3) the amount held in storage; (4) the temperature and quality of the crop, since they together are likely to affect losses in storage; (5) the price at the harvesting period; (6) the prospects of a large early crop in the South; (7) the acreage not harvested; and (8) the amount fed on farms.

Monthly prices paid to producers for cabbage at Little York for thirty-one years are shown in table 56. During this period, in the ten years 1895, 1897, 1898, 1902, 1907, 1910, 1912, 1914, 1915, and 1920, the prices in January and February were not enough higher than the October and November prices to cover shrinkage and other holding charges. This happens in big crop years. For the remaining two-thirds of the seasons,

however, there was a considerable seasonal increase in price, the largest being in 1916 and in 1919, when the January and February prices were from $40 to $60 a ton higher than the October price. Substantial increases in January over the October price that have occurred in other years are: 1899, $9; 1903, $28; 1908, $13; 1909, $15; 1911, $14; 1916, $46; 1917, $15; 1919, $61; 1921, $14; 1923, $9.

TABLE 56. AVERAGE MONTHLY PRICES PAID TO FARMERS FOR WHITE CABBAGE AT LITTLE YORK, FOR THE THIRTY-ONE YEARS FROM 1894 TO 1924

Year	September	October	November	December	January	February	March	April	May
1894–95	.....	$ 4.98	$ 4.60	$ 3.30	$ 5.05	$11.20	$12.00	...	.....
1895–96	......	4.21	4.70	4.74	.....	.....	.....	.	.....
1896–97	....	3.00	2.84	3.00	8.25	8 38	14 52		....
1897–98	$ 4.99	4.90	3.35	5.49	5.96	6.00	6.00	....	....
1898–99	4.99	3.58	3.04	......	....	..	...	....	.....
1899–1900	......	8.22	9.54	15.02	17.61	18.00	18 00	.	....
1900–01	7.01	4.21	5.08	10.82	11.01	10.98	11.20	....	....
1901–02	7.43	7.22	5.83	7.80	8.20	15.90	10.19	..	....
1902–03	4.49	2.34	2.33	3.68	5.27	3.99	4.00	$ 6.49	...
1903–04	......	10.28	11.46	25.83	38.70	39.47	40.26	....	......
1904–05	5.01	4.74	4.93	9.02	7.11	7.59	11.74	8.42	...
1905–06	7.14	7.19	10.06	15.32	15.00	15.86	26.59	30 00	....
1906–07	5.08	8.17	9.74	10.00	10.33	18.29	12.68	8.10	$12.00
1907–08	7.00	7.79	6.00	5.98	5.75	5.82	4 63	....	..
1908–09	13.01	16.27	18.87	25.07	29.25	29.05	29.63	47.82	...
1909–10	8.29	8.73	8.97	16.78	24.01	22 46	20.80	10 00	....
1910–11	5.56	4.85	5.84	7.57	6.43	4.87	6.45	12.11	.....
1911–12	5.94	8.98	10.03	18.50	22.62	34.40	42.77	....	.....
1912–13	3.00	4.21	4.02	3.00	2 87	3.50	3.00	.	...
1913–14	20.00	14.81	15.58	20.81	23.59	19.32	15.03	15 00	......
1914–15	6.77	9.68	9.91	8.00	8.80	6.88	12.34	.....	......
1915–16	.....	4.04	3.88	5.00	5.16	5.01	8.88	7.00	......
1916–17	33.17	32.42	35.64	67.04	78.55	75.00	76.50	......	.....
1917–18	10 29	25.46	19.01	30.66	40.44	44.18	22.25	21.13	......
1918–19	13.10	12 59	12.97	18.37	19.93	20.98	25.73	......	.....
1919–20	30.00	24.65	30.09	58.68	85.58	87.29	89.04	.....	....
1920–21	.	7.09	7.00	7.00	7.63	5.06	5.00	.....	....
1921–22	24 97	25 33	25 00	36 40	39.16	28.03	35.00	...	..
1922–23*	5.21	6 98	7.58	11.93	15.74	26.92	35.71	..	....
1923–24*	20.83	12.13	11.99	16.87	21.04	23.81	27.76	.....	......
1924–25*	.....	7 36	6.11	10.00	15.00	13.16	7.52	.....	.....

* Prices at Homer, five miles south of Little York.

The average increase in the February price over November prices paid to farmers for white cabbage for twenty-eight years, shown in table 57 and as corrected for the price level in table 58, was $8.28 a ton. In wet years it was $5.53 a ton; in years of average rainfall, $10.01 a ton; and in dry years, $9.27 a ton. In wet years the highest price for cabbage is reached in March, in average years in February, and in dry years in January (figure 24). In wet years the abundant supply holds the price down longer. In dry years the short supply becomes evident earlier in the season, with a corresponding earlier advance in price. The advance is also greater in dry years, so that the person who stores then loses less from shrinkage, and receives more per ton over fall prices, than he does in wet years.

Some produce dealers have complimented themselves on the fact that they have never lost direct money on stored cabbage. Almost every year, there is some time during the shipping season when the wholesale price in New York City more than equals the price paid to growers in the fall, plus the transportation. Since the price normally doubles in the

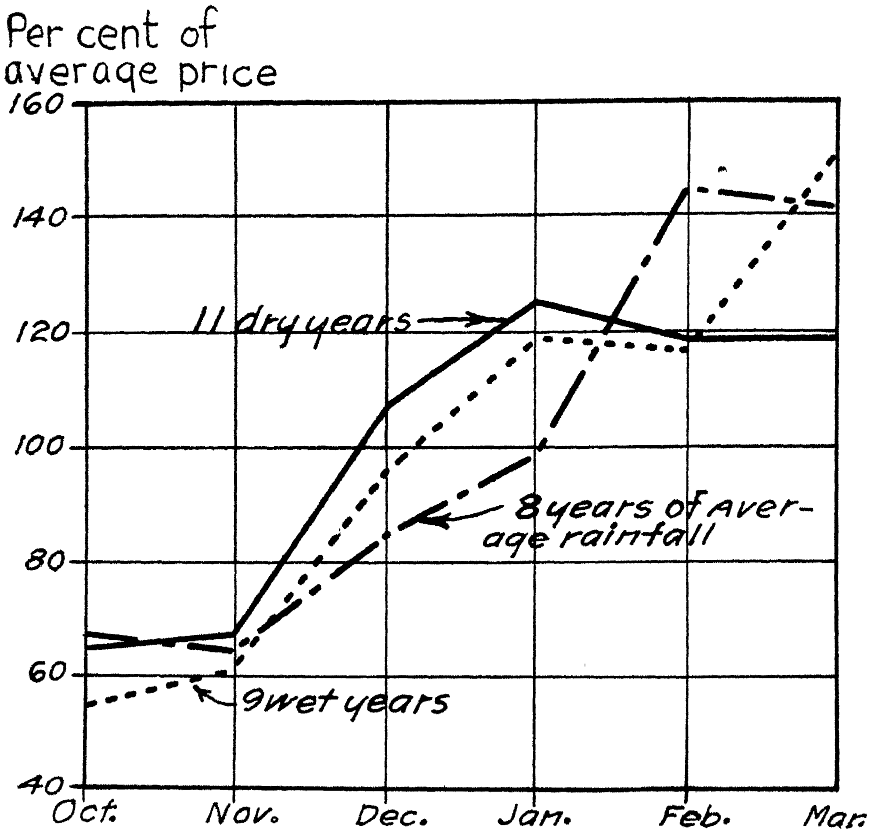


FIGURE 24. SEASONAL VARIATION IN THE SIX-MONTHS AVERAGE PRICE OF CABBAGE PAID TO THE GROWERS

(Dry, average, and wet years grouped separately)

TABLE 57. AVERAGE MONTHLY PRICES PAID TO FARMERS FOR WHITE DANISH CABBAGE, AT LITTLE YORK

(Years in order of precipitation*)

Year	Prices to growers at Little York								
	Rainfall, in per cent of normal	October	November	December	January	February	March	Average	Season's average price per ton paid to growers
1915–16.........	151	$ 4.04	$ 3.88	$ 5.00	$ 5.16	$ 5.01	$ 8.88	$ 5.33	$ 5.00
1920–21.........	126	7.09	7.00	7.00	7.63	5.06	5.00	6.46	6.86
1896–97.........	126	3.00	2.84	3.00	8.25	8.38	14.52	6.66	4.93
1904–05.........	123	4.74	4.93	9.02	7.11	7.59	11.74	7.52	7.66
1902–03.........	120	2.34	2.33	3.68	5.27	3.99	4.00	3.60	4.32
1903–04.........	118	10.28	11.46	25.83	38.70	39.47	40.26	27.67	23.26
1912–13.........	115	4.21	4.02	3.00	2.87	3.50	3.00	3.43	4.09
1910–11.........	112	4.85	5.84	7.57	6.43	4.87	6.45	6.00	5.82
1905–06.........	111	7.19	10.06	15.32	15.00	15.86	26.59	15.00	13.10
Average.....	......	$5.30	$5.82	$8.82	$10.71	$10.41	$13.38	$9.07	......

TABLE 57 (*concluded*)

Year*	Rainfall, in per cent of normal	Prices to growers at Little York							
		October	November	December	January	February	March	Average	Season's average price per ton paid to growers
1922–23	104	$ 6.98	$ 7.58	$11.93	$15.74	$26.92	$35.71	$17.48	......
1906–07	104	8.17	9.74	10.00	10.33	18.29	12.68	11.54	$10.12
1918–19	104	12.59	12.97	18.37	19.93	20.98	25.73	18.43	14.68
1917–18	102	25.46	19.01	30.66	40.44	44.18	22.25	30.33	28.72
1914–15	102	9.68	9.91	8.00	8.80	6.88	12.34	9.27	9.43
1901–02	100	7.22	5.83	7.80	8.20	15.90	10.19	9.19	8.37
1911–12	100	8.98	10.03	18.50	22.62	34.40	42.77	22.88	16.27
1894–95	92	4.98	4.60	3.30	5.05	11.20	12.00†	6.86	4.64
Average	......	$10.51	$9.96	$13.57	$16.39	$22.34	$21.71	$15.75	......
1919–20	90	$24.65	$30.09	$58.68	$85.58	$87.29	$89.04	$62.56	$30.33
1900–01	89	4.21	5.08	10.82	11.01	10.98	11.20	8.88	8.49
1921–22	88	25.33	25.00	36.40†	39.16	28.03	35.00	31.49	26.34
1907–08	84	7.79	6.00	5.98	5.75	5.82	4.63	6.00	6.23
1897–98	83	4.90	3.35	5.49	5.96	6.00†	6.00†	5.28	4.87
1899–1900	79	8.22	9.54	15.02	17.61	18.00	18.00†	14.40	10.75
1908–09	78	16.27	18.87	25.07	29.25	29.05	29.63	24.69	22.84
1909–10	76	8.73	8.97	16.78	24.01	22.46	20.80	16.96	12.93
1916–17	72	32.42	35.64	67.04	78.55	75.00	76.50	60.86	38.81
1923–24	71	12.13	11.99	16.87	21.04	23.81	27.76	18.93	......
1913–14	71	14.81	15.58	20.81	23.59	19.32	15.03	18.19	17.06
Average	......	$14.50	$15.46	$25.36	$31.05	$29.61	$30.33	$24.38	......
1924–25	148	$7.36	$6.11	$10.00	$15.00	$13.16	$7.52	$9.86	......

* 1895–96 and 1898–99 are omitted because of incomplete price data.
† Estimated.

period from October to March, on the average the most important part of the skill that is required, is the determination to buy and store cabbage every year. In twenty-one years out of the past twenty-five the price has advanced. Farmers can operate a storage just as well as a village produce dealer can, but they cannot market quickly enough to take advantage of high prices which exist for only a short time. Dealers who have less other work to attend to can do so.

TABLE 58. AVERAGE MONTHLY PRICES PAID TO FARMERS FOR WHITE CABBAGE, AT LITTLE YORK, CORRECTED FOR PRICE LEVEL

(Years in order of precipitation)

Year	Rainfall, in per cent of normal	Corrected prices to growers at Little York						
		October	November	December	January	February	March	Average
Wet years (rainfall more than 110 per cent of normal):								
1915–16	151.4	$ 3.88	$ 3.66	$ 4.55	$ 4.49	$ 4.28	$ 7.34	$ 4.70
1920–21	125.7	3.30	3.50	3.83	4.41	3.10	3.16	3.55
1896–97	125.7	4.41	4.18	4.41	12.13	12.32	21.35	9.80
1904–05	122.9	5.45	5.60	10.25	8.17	8.72	13.65	8.64
1902–03	120.0	2.66	2.68	4.18	5.86	4.43	4.44	4.04
1903–04	117.8	11.82	13.17	29.69	43.98	44.35	45.24	31.38
1912–13	115.4	4.13	3.94	2.94	2.81	3.43	2.94	3.36
1910–11	112.4	4.75	5.73	7.42	6.77	5.13	6.79	6.10
1905–06	110.6	8.08	11.18	16.84	16.67	17.62	29.54	16.66

TABLE 58 (*concluded*)

Year	Rainfall, in per cent of normal	Corrected prices to growers at Little York						
		October	November	December	January	February	March	Average
Average years (rainfall 90–110 per cent of normal):								
1922–23	104.3	$ 4 45	$ 4 77	$ 7.50	$ 9.90	$16.82	$12.04	$10.91
1906–07	103.6	8 88	10 47	10 53	10.87	19.05	13 21	12.17
1918–19	103.5	6.11	6.27	8.92	9 82	10.65	12.86	9.10
1917–18	102.4	13 61	10.17	16.48	21.51	23.25	11.65	16.11
1914–15	101 5	9 78	10.01	8 08	8.80	6 81	12.22	9.28
1901–02	100.1	8.80	7 11	9.51	9 76	18.93	12.13	11.04
1911–12	100.1	9 45	10.56	19.47	22.85	34.75	42.77	23.31
1894–95	92.5	7.11	6.57	4.71	7 11	15.77	16.90	9.70
Dry years (rainfall less than 90 per cent of normal):								
1919–20	89.7	$11.47	$13.62	$25.74	$35.96	$36.83	$37.26	$26.81
1900–01	89.3	5.13	6.20	13.20	13.59	13.56	13.83	10.92
1921–22	87.7	17.47	17 36	25.45	27 77	19.47	24.14	21.94
1907–08	83.6	8.03	6.25	6.36	6.12	6.26	4.98	6.33
1897–98	82 7	7.21	4.93	8.07	8.39	8.45	8.45	7.58
1899–1900	79.2	10 68	12 39	19.51	21.22	21.69	21.69*	17.86
1908–09	78.3	17.88	20.74	26.96	30.15	29.95	30.55	26.04
1909–10	75.5	8.64	8.79	16.29	23.09	21.60	19.81	16.37
1916–17	71.9	23.32	23.92	44.11	50.35	46.88	46.36	39.16
1923–24	71.3	7 78	7.74	10.95	13.66	15.36	18 14	12.27
1913–14	70.6	14.38	15.27	20.60	23.59	19.13	15.03	18.00

VALUE PER ACRE WITH VARYING YIELDS

The value of a cabbage crop at varying rates of yield per acre at November and at January prices is shown in table 59. The average value per acre of a 6-ton yield at the November prices obtained at Little York ranged from $14 in 1902 to $214 in 1916, with an average of $62 for twenty-eight years. At January prices, with a 16-per-cent shrinkage the value of this yield ranged from $14 in 1912 to $431 in 1919, with an average of $103, which is $41 an acre, or 66 per cent, higher than the November value. This is not $41 an acre above expenses, but the costs of holding are chiefly those for shrinkage and labor. With a yield of 12 tons, the January value over the November value of the cabbage from an acre was $81, or double that with a 6-ton yield. Here lies the explanation of the development of commercial storehouses for cabbage, for, on the average, the holding of cabbage till January has been good business.

TABLE 59. GROSS INCOME PER ACRE FROM CABBAGE AT NOVEMBER PRICES WITH VARYING YIELDS, AND AT JANUARY PRICES, ASSUMING 16-PER-CENT SHRINKAGE AND LOSS

	Value at November prices				Value at January prices			
Tons per acre	6	8	10	12	6	8	10	12
1894–95	$28	$37	$ 46	$ 55	$ 25	$ 34	$ 42	$ 51
1895–96	28	38	47	56	*	......	......	......
1896–97	17	23	28	34	42	55	69	83
1897–98	20	27	34	40	30	40	50	60
1898–99	18	24	30	36	*	......	......	......
1899–1900	57	76	95	114	89	118	148	178
1900–01	30	41	51	61	55	74	92	111
1901–02	35	47	58	70	41	55	69	83
1902–03	14	19	23	28	27	35	44	53
1903–04	69	92	115	138	195	260	325	390
1904–05	36	48	60	72	56	48	60	72
1905–06	60	80	101	121	76	101	126	151
1906–07	58	78	97	117	52	69	87	104
1907–08	36	48	60	72	29	39	48	58

TABLE 59 (*concluded*)

	Value at November prices				Value at January prices			
Tons per acre,	6	8	10	12	6	8	10	12
1908–09	$113	$151	$189	$226	$147	$197	$246	$295
1909–10	54	72	90	108	121	161	202	242
1910–11	35	47	58	70	32	43	54	65
1911–12	60	80	100	120	114	152	190	228
1912–13	24	32	40	48	14	19	24	29
1913–14	93	125	156	187	119	159	198	238
1914–15	59	79	99	119	44	59	74	89
1915–16	23	31	39	47	26	35	43	52
1916–17	214	285	356	428	396	528	660	792
1917–18	114	152	190	228	204	272	340	408
1918–19	78	104	130	156	100	134	167	201
1919–20	181	241	301	361	431	575	719	863
1920–21	42	56	70	84	38	51	64	77
1921–22	150	200	250	300	197	263	329	395
Average	$62	$83	$104	$125	$103	$138	$172	$206
1922–23	$45	$61	$ 76	$ 91	$ 79	$105	$132	$159
1923–24	72	96	120	144	105	141	177	213
1924–25	37	49	61	73	75	100	126	152

* Since no data were available for these years, it is assumed that the increase in price was proportional with that in other years.

PURCHASING POWER

A comparison of the United States Bureau of Labor index number of wholesale prices of all commodities for the United States, and the index numbers of prices for cabbage, is shown in table 60 and in figure 25. Four facts are shown by this comparison: (1) that the range of fluctuation in

TABLE 60. INDEX NUMBERS OF WHOLESALE PRICES OF ALL COMMODITIES FOR THE UNITED STATES, COMPARED WITH INDEX NUMBERS OF PRICES PAID TO FARMERS FOR CABBAGE AT LITTLE YORK

(Average of prices from 1910 to 1914 = 100)

Year	Wholesale prices in United States	Cabbage prices at Little York*	Purchasing power of cabbage
1894–95	70	44	63
1895–96	71	43	61
1896–97	68	47	69
1897–98	68	46	68
1898–99	71	31	44
1899–1900	77	102	132
1900–01	83	81	98
1901–02	81	79	98
1902–03	86	41	48
1903–04	88	221	251
1904–05	88	73	83
1905–06	88	124	141
1906–07	91	96	105
1907–08	96	59	61
1908–09	92	217	236
1909–10	99	123	124
1910–11	103	55	53
1911–12	95	155	163
1912–13	101	39	39
1913–14	102	162	159
1914–15	100	90	90
1915–16	103	47	46

TABLE 60 (*concluded*)

Year	Wholesale prices in United States	Cabbage prices at Little York*	Purchasing power of cabbage
1916–17	130	369	284
1917–18	181	273	151
1918–19	198	139	70
1919–20	210	288	137
1920–21	231	65	28
1921–22	150	250	167
1922–23	152	166	109
1923–24	157	180	115
1924–25	153	94	61

* The season's average prices were used prior to 1922, and since then the simple average prices paid to growers by H. A. Litz, of Homer, New York, were used.

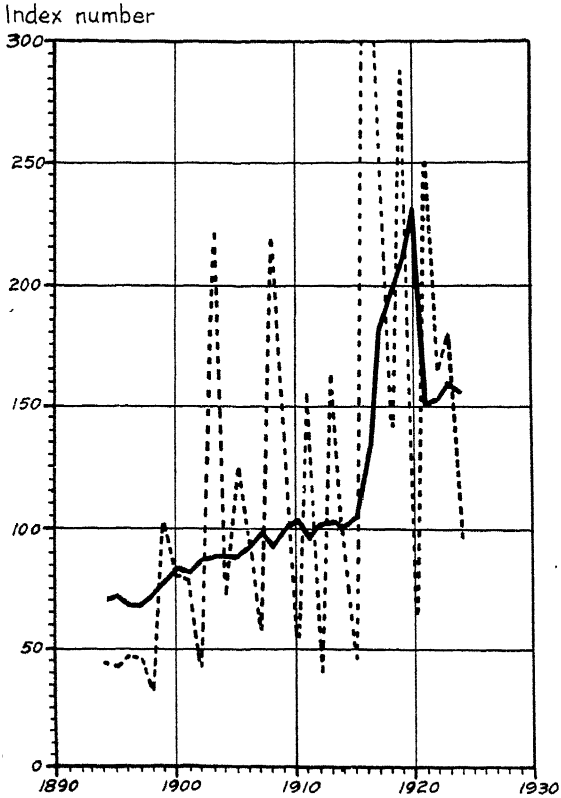


FIGURE 25. INDEX NUMBERS OF WHOLESALE PRICES IN THE UNITED STATES, AND OF PRICES PAID TO GROWERS FOR WHITE DANISH CABBAGE AT LITTLE YORK

The average for the years 1910 to 1914, inclusive, is taken as 100. The solid line indicates wholesale prices; the dotted line, prices paid to the growers

the yearly prices of cabbage, as compared with the average of a large number of commodities in the United States, is extreme; (2) that cabbage prices relative to prices in general have been higher in recent years than in the earlier years of the industry; (3) that cabbage prices and the prices of all commodities were extremely high during the war; and (4) that exceptional changes in the general price level are accompanied by greater changes in the prices of cabbage, a highly speculative crop, than are normal year-to-year changes in general prices.

The index number of the purchasing power for the first ten years of the prices, from 1894 to 1903, was 96, and that for the last ten years, from 1912 to 1921, was 114, or 19 per cent higher (table 60). The price of cabbage

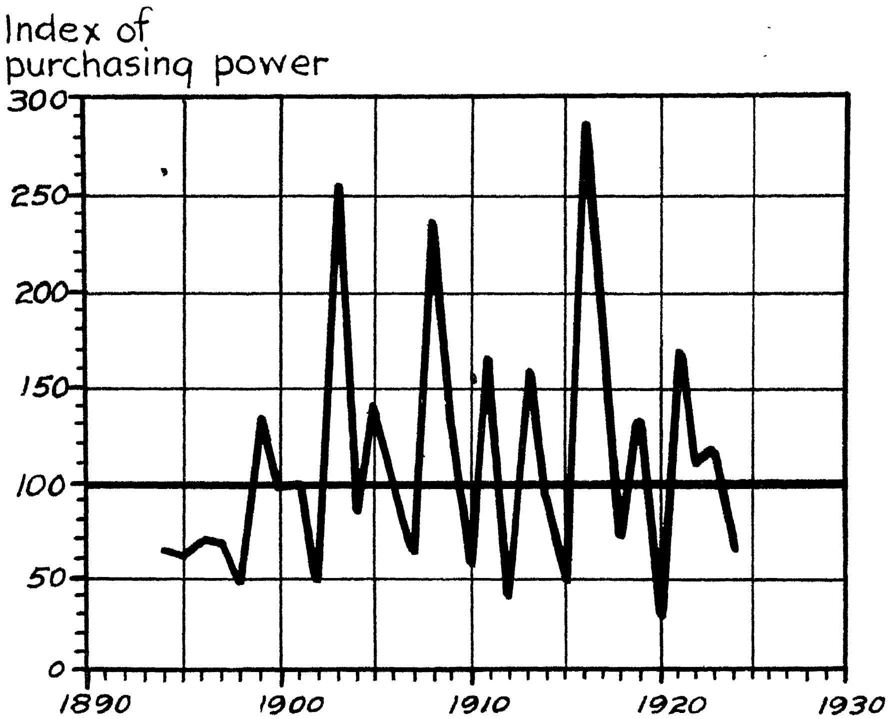


FIGURE 26. PURCHASING POWER OF MONEY PAID TO FARMERS AT LITTLE YORK FOR CABBAGE, FROM 1894 TO 1924, INCLUSIVE

was highest relative to the United States price level in 1916, when it was 3.69 times the 1910–1914 average price; it was lowest relative to the general price level in 1920, when it was 65 per cent of the 1910–1914 average.

One explanation of the fact that the purchasing power of the money received by farmers for cabbage has been higher in recent years, is that in the earlier years of the industry domestic cabbage was raised, and this was not held to any extent, more of the cabbage being sold at fall prices. Then the better-keeping Danish became the type almost exclusively used, and the practice of storing increased so that some of the jobs of the distributing end were undertaken by the grower. More of the cabbage then sold from farms at midwinter prices. In other words, the introduction of a new type of product, and of storage operations by which the period over which the crop might be marketed is prolonged, has increased the purchasing power of the seasonal price of cabbage.

Price alone does not determine the value of a crop, but price times the yield. When the yield is low the price is high, and when the yield is high the price is low; but the value per acre of the crop in low-price years is more than the price would suggest, because of the very large yield in those years. The yield in 1920 was 215 per cent of the yield in 1916. There are very few crops that show as large a variation in yield per acre as does cabbage. The variations in yield, price, and value per acre, are indicated in table 61:

TABLE 61. VARIATION IN YIELD PER ACRE, PRICE PER TON, AND VALUE PER ACRE, OF CABBAGE

Year	Average yield per acre for New York (tons)	November price to growers at Little York, per ton	Value per acre
1915	10.0	$ 3.88	$ 39
1916	5.4	35.64	192
1917	7.3	19.01	139
1918	9.1	12.97	118
1919	6.5	30.09	196
1920	11 6	7.00	81
1921	6.5	25.00	162
1922	9.0	7.58	68
1923	7.5	11.99	90
1924	11.4	6.11	70
Average	8.4	$15.93	$116

ADJUSTING PRODUCTION TO PRICE

INCOME FROM CABBAGE ON A SUCCESSFUL FARM

The production of cabbage on one farm at Little York for nine years is given in table 62. This grower has always sold his crop at harvesting time. The average acreage was 9.1 per year, the average yield 11.7 tons per acre, the average price received $10.96 for domestic cabbage for the years it was grown, $14.14 for Danish for the same years as for domestic, and $13.32 for Danish as a nine-years average. The gross returns per acre varied from $54 to $310, and averaged $153 for the nine years. The average receipts on this farm from cabbage were $1400 per year.

TABLE 62. PRODUCTION AND RECEIPTS FOR CABBAGE ON A HIGHLY SUCCESSFUL FARM

Year	Acres	Amount sold by farmer (tons)	Danish			Receipts						
			Amount stored by buyer (tons)	Amount laid down by buyer (tons)	Amount carred directly by buyer (tons)	Domestic		Danish			Total	Gross per acre
						Tons	Value	Tons	Price	Value		
1914	12	140 93	59.22	62.04	5 25	14.42	$101	126 51	$10.00	$1,265	$1,366	$114
1915	10	133.30	94.02	23.88	15.40	......	......	133.30	4.06	541	541	54
1916	5.5	42.64	......	......	37.01	5.63	178	37.01	31.23	1,156	1,334	243
1917	11	113 96	61.98	......	51.98	......	......	113.96	22.17	2,526	2,526	230
1918	7	67 70	49.95	......	4.2	13.55	157	54.15	15.00	812	969	138
1919	9.5	79 70	57 39	......	......	22.31	356	57.39	27.00	1,550	1,906	201
1920	8.5	153.94	68 90	......	85.04	......	......	153.94	7.16	1,102	1,102	130
1921	5.8	71.84	......	......	......	......	......	71.84	25.00	1,796	1,796	310
1922	13	157.22	72.94	......	54 28	30 00	150	127.22	7.13	907	1,057	81
Total	82.3	961 23	......	......	......	85 91	$942	875 32	......	$11,655	$12,597	$153
Average	9.1	11 7*	.....	......	......	.....	......	......	$13.32	......	......	....

* Yield per acre.

The average yearly price which this farmer received for Danish cabbage, as compared with the average price paid for Danish at the shipping point, was as shown in table 63:

TABLE 63. COMPARISON OF AVERAGE YEARLY PRICE RECEIVED BY ONE FARMER WHO ALWAYS SOLD AT HARVESTING PERIOD, WITH AVERAGE PRICE PAID FOR ALL DANISH CABBAGE AS PURCHASED BY F. N. SALISBURY AT LITTLE YORK

Year	Farmer's price	Average price for all cabbage purchased
1914	$10.00	$ 9.29
1915	4.06	5.00
1916	31.23	38 49
1917	22.17	28.14
1918	15 00	14 48
1919	27.00	30 32
1920	7.16	6.86
1921	25.00	26.23
1922	7.13	....
Average for first eight years (1914 to 1921)	$17 70	$19.85

Altho this farmer has followed a regular practice of selling in the fall, the average price received for his cabbage for the eight years from 1914 to 1921 was only $2.15 less than the average price paid by the purchaser for all cabbage purchased from farmers during the season. The chief reason for the difference being so low is that most of the cabbage is sold in the fall by other farmers, just as it was by the farmer in question.

INCOME IF CABBAGE HAD BEEN STORED

The years 1914, 1915, 1920, 1922, and 1923 were years of relatively large cabbage crops in the northern States. If the crops had always been of such quality as to justify holding them, if the farmer had been in a position to hold the entire crop each of these years, and if the shrinkage had been 20 per cent, the farmer here concerned would have received a total of $905 more, which is $181 more per year, or $1.18 more per ton of cabbage harvested and sold. It is plain that on the whole it would not have paid him to hold his cabbage in these years; when labor and costs other than shrinkage are considered, he would have lost money.

The years 1916, 1917, 1918, 1919, and 1921 were years of relatively small crops in the northern States, according to governmental reports. If this farmer had held the entire crop each of these years till January, with a shrinkage of 20 per cent he would have received a total of $6644 more, which is $1329 more per year, or $17.62 more per ton of cabbage harvested and sold. The facts are, however, that in some years the quality of the crops was not good enough to warrant holding.

The total advance in value of 1143 tons of cabbage harvested and sold from the farm for the ten years from 1914 to 1923, inclusive, if it is assumed that January prices could have been obtained and that the shrinkage was 20 per cent, was $7549.

The average of the index numbers of wholesale prices of all commodities for the years of large crops was 149, and for the years of small crops 174. When allowance is made for the difference in price level, the increased amount of income that might have resulted on this farm from holding the cabbage crop till January was 12.8 times as much in the years of small, as in the years of large, northern crops.

INCOME WITH UNIFORM ACREAGE ANNUALLY

In the five years of large crops in the late-cabbage States, this farmer grew an average of 11 acres of cabbage producing 766 tons, an average yield of 13.9 tons per acre; while in the five years of small crops in the late-cabbage States, he grew an average of 7.8 acres producing 377 tons, an average yield of 9.7 tons per acre (table 64). In only one year out of the five when the crop was large in the late-cabbage States, did he have a small acreage; and, conversely, in only one year out of the five when the country's crop was small, did he have a large acreage. Not only was the yield per acre 30 per cent less in the five years of a generally short crop, but this farmer was caught with an average 29-per-cent reduction in acreage in those years. This prevented him from realizing the high price to the fullest extent.

TABLE 64. COMPARISON OF INCOME FROM VARYING ACREAGES AS GROWN ON ONE NEW YORK FARM, WITH WHAT THE INCOME WOULD HAVE BEEN IF THE CABBAGE HAD BEEN HELD TILL JANUARY

Year	Size of northern crop (car-loads, in thousands)	Acres of cabbage grown	Total yield (tons)	Value when all was sold in fall	All held till January, with a 20-per-cent shrinkage		Difference between income as crop was sold or if all were held till January
					Tons	Value	
	Years of large northern crop						
1914	54*	12.0	141	$1,366	113	$ 994	—$372
1915	52	10.0	133	541	106	547	+ 6
1920	53	8.5	154	1,102	123	938	— 164
1922	50	13.0	157	1,057	126	1,983	+ 926
1923	40	11.5	181	2,542	145	3,051	+ 509
Total	..	55.0	766	$6,608	613	$7,513	+$905
	Years of small northern crop						
1916	20	5.5	43	$1,334	34	$2,671	+$1,337
1917	38	11.0	114	2,526	91	3,680	+ 1,154
1918	39	7.0	68	969	54	1,076	+ 107
1919	31	9.5	80	1,906	64	5,477	+ 3,571
1921	27	5.8	72	1,796	58	2,271	+ 475
Total	..	38.8	377	$8,531	301	$15,175	+$6,644

* Six States.

The varying of the acreage planted to cabbage so as to have a large crop when prices are high, and to avoid the expense of handling a large crop when the price hardly meets this expense, cannot be planned by rule, because the weather must be considered.

The variations of the acreage of cabbage grown by this farmer, the total amount received for the crop for the ten years from 1914 to 1923, inclusive, and a computation of the amount that would have been received if a uni-

form area of 9.4 acres had been grown each year, are shown in table 65. In six of the ten years he would have received a total of $1468 less, and in four of the ten years he would have received a total of $2506 more, than he did receive. This is a net difference of $1038 more, which probably would not have been adequate compensation for the losses that might have resulted from disturbing his farming system in order to grow a uniform acreage each year. If it can readily be done, however, planting the same acreage each year will probably give greater returns to the majority of producers.

TABLE 65. COMPARISON OF ACTUAL INCOME FROM VARYING YEARLY ACREAGES OF CABBAGE ON ONE NEW YORK FARM FOR TEN YEARS, WITH PROBABLE INCOME FROM UNVARYING AVERAGE ANNUAL ACREAGE WITH THE YIELDS AND PRICES WHICH PREVAILED

Year	Acres of cabbage grown	Total yield (tons)	Yield per acre (tons)	Price received per ton	Total amount received for cabbage	If annual average acreage had been grown and yield and price had been the same			
						Total yield (tons)	Total value	Increase above actual receipts	Decrease below actual receipts
1914	12.0	141	11.8	$ 9.69	$1,366	110.9	$1,075	......	$291
1915	10.0	133	13.3	4.06	541	125.0	508	...	33
1916	5.5	43	7.8	31.02	1,334	73.3	2,274	$ 940	......
1917*	11.0	114	10.4	22.17	2,526	97.8	2,168	...	358
1918	7.0	68	9.7	14.25	969	91.2	1,300	331	......
1919	9.5	80	8.4	23.82	1,906	79.0	1,882	......	24
1920	8.5	154	18.1	7.16	1,102	170.1	1,218	116	....
1921	5.8	72	12 4	25.00	1,796	116 6	2,915	1,119	....
1922	13 0	157	12.1	6.73	1,057	113.7	765	......	292
1923	11 5	181	15.7	14.04	2,542	147.6	2,072	......	470
Total or average	9.4	1,143	12.2	$13.24	$15,139	1,125.2	$16,177	$2,506	$1,468
Net increase	.....	.....	......	.....	......	......	+$1,038	......	....

* Includes landlord's half of crop, on shares.

INCOME WITH ACREAGE ADJUSTED ACCORDING TO PRICE FOR PRECEDING YEAR

Another alternative for this farmer would have been to vary the acreage each year according to the price received for cabbage the preceding season. For example, in 1915 the average price received by this farmer for his cabbage was $4.06 a ton. In that year he grew 10 acres. He might have reasoned that because cabbage was low in 1915, many growers would be discouraged, the general acreage would be decreased, and therefore he should increase his own acreage. He could not, of course, forecast the weather. If he had planted 15 acres in 1916 and the yield had been the same, he would have received $2295 more than he did receive by planting 5.5 acres; but he reduced the acreage, the same as other growers did. In 1917, if he had followed a consistent policy in varying the acreage he would have reduced it decidedly, because of the $31 price in 1916. If he had planted 4 acres, he would not have been so well off as he was by increasing the acreage in 1917, because the 1917 price was $22.17 a ton. Since high prices had prevailed for two years, he might have expected that the price in the succeeding year would be relatively low. This was the case in 1918, the price being $14.25 a ton. Since the general price level stood at about twice the pre-war normal in 1918, this was a very low price, from the standpoint of purchasing power. It might have been expected that in the next year prices would be high, and therefore the

acreage should be increased. This would have been a wise step, as the price was $23.82 in 1919. After as high a price as this, it might have been expected that in the succeeding year the price would be low, and that therefore a wise procedure would be to limit the acreage. This would have been advantageous, as the price in 1920 was $7.16 a ton. After this low price it might have been expected that the price for the next year would be high, and that the acreage should therefore have been increased. This increase would have been profitable, because the price in 1921 was $25 a ton. The next year would have been the year to decrease the acreage, and this procedure would have been correct, as the price then was $6.73 a ton. The following year, 1923, would have been the year to increase the acreage, and this also would have been correct, as the price was $14.04 a ton — not an extremely high price, but a good price. If this farmer had grown 93.8 acres of cabbage, the same acreage that he did grow during these nine years, but had increased the acreage after a year of low prices, and decreased the acreage after a decidedly high price to the extent indicated in table 66, and the year's price had been the same as he received, he would have had from his cabbage $18,419, or $4646 more money than he did receive. He would have handled 84 tons more cabbage with this arrangement.

TABLE 66. INCOME FROM CABBAGE ON A NEW YORK FARM IF THE ACREAGE HAD BEEN WIDELY VARIED ACCORDING TO THE PRICE RECEIVED THE PRECEDING YEAR

Year	Price received per ton	Acres	Tons	Receipts on basis of varying the acreage according to price in the preceding year
1915	$ 4 06	10	133	$ 541
1916	31.02	15	117	3,629
1917	22.17	4	42	931
1918	14 25	7 8	76	1,083
1919	23 82	15	126	3,001
1920	7 16	6	109	780
1921	25 00	15	186	4,650
1922	6.73	6	73	491
1923	14.04	15	236	3,313
Total	......	93 8	1,098	$18,419
Actual production and income on this farm for nine years	..	..	1,014	$13,773
Difference	......	...	....	$ 4,646

From the preceding discussion it appears that a consistent policy of increasing the acreage after a year of low prices, and decreasing it after a year of high prices, would result in a greater income from cabbage than that obtained from either a uniform acreage each year or the acreage as grown by this farmer. Careful study, however, will show that the reason for this is not so much that farmers in general decreased the acreage after a year of low prices and increased it after a year of high prices, but that during the last nine years the rainfall over the commercial cabbage district has varied in such a way that a farmer who followed this policy

would have been in luck by having a large acreage in dry years, when the yield per acre was much less than usual. Unfortunately there is no assurance that the weather will vary in this manner, and since prices depend more on variations in yield per acre than on variations in acreage grown, there is no certainty that varying the acreage in this way will increase the income over a period of years. It seems that the adage about success in growing cabbage depending on a large acreage of good cabbage in a year of high prices, and a large acreage of good plants to sell the following year, conveys more wit than wisdom.

Radical changes from year to year in the acreage of cabbage grown, such as are indicated in table 66, presuppose that as much land as is there indicated can be used for growing cabbage without risk of serious harm from clubroot and other cabbage diseases. They also presuppose that the increased acreage of cabbage precludes a similar acreage of a crop less profitable than cabbage. While it did not displace a less profitable crop on this farm because hay was the crop superseded by it, on many farms it would have taken the place of potatoes and intensively cultivated crops subject to the same climatic influences. That is, the high price of cabbage is due chiefly to lack of rainfall, which also raises the price of potatoes. The difference in the receipts of cabbage, therefore, is not the only consideration. The receipts from the other crops should also be known in order to determine whether or not such a variation in the acreage would result in greater profits.

CABBAGE GROWN IN SMALL ACREAGES

The data in table 67 have been assembled from various surveys conducted by the College in counties where much cabbage is grown. The importance of cabbage as a cash crop is indicated by the range in average receipts per farm from this source, these ranging from $159 in Monroe County in 1914, to $1233 in Cortland and Onondaga Counties in 1921. The average returns per acre ranged from $49 in Cayuga County in 1914, to $305 in Cortland and Onondaga Counties in 1921.

TABLE 67. DATA ON PRODUCTION OF CABBAGE ON NEW YORK FARMS INCLUDED IN FARM-MANAGEMENT SURVEYS

County	Area	Crop year	Number of farms surveyed	Number of farms growing cabbage	Acres per farm growing cabbage	Tons per farm	Tons per acre	Price per ton	Receipts per farm from cabbage	Receipts per acre from cabbage
Niagara	....	1921	171	66	2.1	8	3.6	$28.77	$ 200	$ 95
Monroe	....	1914	106	57	3.2	23	7.1	7.68	159	50
Livingston	Avon	1918	133	16	3.1	24	7.8	13.46	322	103
	Caledonia	1918	121	29	2.9	16	5.5	12.49	193	66
	Lima	1918	148	81	3.2	22	6.9	15.97	351	109
Cayuga	....	1914	53	27	2.7	20	7.4	7.39	133	49
Cortland and Onondaga	Homer and Tully	1921	51	42	4.0	41	10.1	31.37	1,233	305

Where cabbage is a cash crop in a system of either general or dairy farming, it is grown in small acreages. The most common acreage per farm is from 2 to 3 acres. In only two areas studied did as high as 1 per cent of the farms have 10 acres or more of cabbage (table 68).

TABLE 68. PROPORTION OF FARMS INCLUDED IN SELECTED FARM-MANAGEMENT SURVEYS GROWING ACREAGE OF CABBAGE INDICATED*

County or area	Niagara County	Monroe County	Livingston County				Cayuga County	Tully and Homer area	Earlville area	Munnsville area	Oxford area	Norwich area	Dryden area
			Caledonia	York	Lima	Avon							
Number of farms included in survey	171	106	121	168	148	133	53	51	126	125	84	83	252
Year	1921	1914	1918	1918	1918	1918	1914	1921	1921	1921	1921	1921	1917
Acres of cabbage grown	Per cent of total number having each acreage indicated												
0	61.4	46.2	76.0	81.0	45.2	88.0	49.0	17.6	35.7	94.4	97.6	91.6	84.9
Less than 1	5.3	1.9	0.8	4.1	1.4	1.5	1.9	....	4.8	1.6	2.4	3.6	10.7
1–1.9	12.2	8.5	5.7	4.1	8.1	0.7	9.4	3.9	17.5	1.6	....	3.6	2.4
2–2.9	11.7	14.2	8.3	5.4	12.8	3.8	22.6	19.6	21.4	1.6	....	1.2	1.6
3–3.9	4.1	11.3	2.5	1.8	12.8	2.3	3.8	15.7	6.3	0.8	....	....	0.4
4–4.9	3.5	6.6	2.5	2.4	9.5	2.3	3.8	15.7	5.6	....	....	....	....
5–5.9	....	3.8	1.7	....	5.4	0.7	3.8	13.7	6.3	....	....	....	....
6–6.9	0.6	3.8	....	0.6	2.0	....	1.9	5.9	....	....	....	....	....
7–7.9	0.6	0.9	0.8	....	1.4	....	1.9	....	....	....	....	....	....
8–8.9	0.6	1.9	....	0.6	....	....	1.9	2.0	0.8	....	....	....	....
9–9.9	....	0.9	....	....	0.7	....	....	3.9	....	....	....	....	....
10–10.9	....	....	1.7	....	0.7	0.7	....	2.0	....	....	....	....	....
11–11.9	....	....	....	....	....	....	....	....	....	....	....	....	....
12–12.9	....	....	....	....	....	....	....	....	....	....	....	....	....
13–13.9	....	....	....	....	....	....	....	....	0.8	....	....	....	....
14–14.9	....	....	....	....	....	....	....	....	....	....	....	....	....
15–15.9	....	....	....	....	....	....	....	....	0.8	....	....	....	....
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* This table was furnished by Professor G. P. Scoville.

PREDICTING THE PRICE OF CABBAGE TO GROWERS

FORECASTING PRICE FROM RAINFALL

The price received for a crop such as cabbage depends largely on the production. A fairly reliable indication of the price to be expected can be seen from the forecasts of production published in *Crops and Markets*, issued by the United States Department of Agriculture. Since the relation between the amount of rainfall and the production is so close with cabbage, the amount of rainfall is a very satisfactory substitute for production in calculating the price to be expected for the crop. The coefficient of correlation between the percentage of the normal amount of July, August, and September rainfall in the New York commercial-cabbage district, and the percentage of the normal November price to growers at Little York, New York, for thirty years, is -0.572 ± 0.083.

The producer is interested in forecasting whether the price will be \$5, \$10, \$15, \$20, or \$25, and not so much in small variations. While it is not possible to predict prices with absolute certainty, some indication of the expected price can be worked out by formula. The method given here is based on the fact that, for thirty years, about three times as large a departure from normal of the November prices paid to farmers at Little York have accompanied the departures from normal of rainfall, and the formula used is:

$$P = L \times C \begin{cases} + (C \times \text{departures in rainfall below normal} \times 3) \\ \text{or} \\ - (C \times \text{departures in rainfall above normal} \times 3) \end{cases}$$

In this formula

P = the price of cabbage to be predicted,
L = the wholesale price level of "all commodities," reported by the United States Bureau of Labor,
and C = the average November price of cabbage, corrected by dividing the actual price by the index number of wholesale prices.

Two methods of applying the formula are shown in table 69, one with three ten-years averages, and the other with the use of a cumulative average for the first ten years and after this a ten-years average.

The index numbers of wholesale prices used in this calculation are: for 1894 to 1899, inclusive, the annual index found on page 4 of Bulletin 416 of the Cornell University Agriculture Experiment Station; for 1900 to 1922, inclusive, those found on page 5 of the same bulletin; for 1923, the August index found on page 90 in *Farm Economics* for February, 1924.

The purpose in using the August index for the years when monthly indexes are available is that the number is known about the middle of September, and is thus the latest number that can be used, if October or November prices are to be predicted early enough to allow producers to make plans for marketing.

The correlation between the rainfall, the total tons of cabbage produced in New York, and the November price for cabbage to growers at Little York, each in percentage of the nine-years average for the years 1915 to 1923, inclusive, is shown in figure 27. The data are given in tables 19, 24, and 56.

TABLE 69. ANNUAL PREDICTIONS OF CABBAGE PRICES FROM THE FORMULA PREVIOUSLY GIVEN; COMPARED WITH ACTUAL PRICES FOR NOVEMBER

Year	Ten-years average, corrected for price level	Departure in rain × 3, + or —	Correction for rain, + or —	Predicted November price corrected	Index number for U. S. wholesale prices	Predicted price	Actual price	Amount predicted price is above or below actual price	Average corrected for price level	Correction for rain, + or —	Predicted November price corrected	Predicted price	Amount predicted price is above or below actual price
1894	$ 6.83	— 22.5	+$ 1.54	$ 8.37	70	$ 5.86	$ 4.60	+$ 1.26	$ 6.57	... ...	...	...	...
1895	6.83	— 26.7	+ 1.82	8.65	71	6.14	4.70	+ 1.44	6.57	+$ 1.75	$ 8.32	$ 5.91	+$ 1.21
1896	6.83	+ 77.1	— 5.27	1.56	68	1.06	2.84	— 1.78	6.60	— 5.09	1.51	1.03	— 1.81
1897	6.83	— 51.9	+ 3.54	10.37	68	7.95	3.35	+ 3.70	5.79	+ 3.01	8.80	5.98	+ 2.63
1898	6.83	+ 63.6	— 4.34	2.49	71	1.77	3.04	— 1.27	5.58	— 3.55	2.03	1.44	— 1.60
1899	6.83	— 62.4	+ 4.26	11.09	77	8.54	9.54	— 1.00	5.32	+ 3.32	8.64	6.65	— 2.89
1900	6.83	— 32.1	+ 2.19	9.02	82	7.49	5.08	+ 2.32	6.50	+ 2.09	8.59	7.04	+ 1.96
1901	6.83	+ 0.3	— 0.02	6.81	81	5.52	5.83	— 0.31	6.45	— 0.02	6.43	5.21	— 0.62
1902	6.83	+ 60.0	— 4.10	2.73	85	2.32	2.33	— 0.01	6.55	— 3.93	2.62	2.23	— 0.10
1903	6.83	+ 53.4	— 3.65	3.18	87	2.77	11.46	— 8.69	6.12	— 3.27	2.85	2.48	— 8.98
1904	9.94	+ 68.7	— 6.83	3.11	87	2.71	5.00	— 2.29	6.83	— 4.69	2.14	1.86	— 3.14
1905	9.94	+ 31.8	— 3.16	6.78	88	5.97	10.06	— 4.09	6.75	— 2.15	4.60	4.05	— 6.01
1906	9.94	+ 10.8	— 1.07	8.87	91	8.97	9.74	— 1.67	7.23	— 0.78	6.45	5.87	— 3.87
1907	9.94	— 49.2	+ 4.89	14.83	97	14.39	6.00	+ 8.39	7.88	+ 3.88	11.76	11.41	+ 5.41
1908	9.94	— 65.1	+ 6.47	16.41	91	14.93	18.87	— 3.94	8.00	+ 5.21	13.21	12.02	— 6.85
1909	9.94	— 73.5	+ 7.31	17.25	99	17.08	8.97	+ 8.11	9.65	+ 7.09	16.74	16.57	+ 7.60
1910	9.94	+ 37.2	— 3.70	6.24	102	6.36	5.84	+ 0.52	9.32	— 3.47	5.85	5.97	+ 0.13
1911	9.94	+ 0.3	— 0.03	9.91	95	9.41	10.03	— 0.62	9.27	— 0.03	9.24	8.78	— 1.25
1912	9.94	+ 46.2	— 4.59	5.35	101	5.40	4.02	+ 1.38	9.61	— 4.44	5.17	5.22	+ 1.20
1913	9.94	— 88.2	+ 8.77	18.71	102	19.08	15.58	+ 3.50	9.73	+ 8.58	18.31	18.68	+ 3.10
1914	10.40	+ 4.5	— 0.47	9.93	103	10.23	9.91	+ 0.32	9.94	— 0.45	9.49	9.77	— 0.14
1915	10.40	+154.2	—16.04	— 5.64	102	4.09	3.88	+ 0.12	10.33	—15.93	— 5.60	4.00	+ 0.12
1916	10.40	— 84.3	+ 8.77	19.17	129	24.73	35.64	—10.91	9.56	+ 8.06	17.62	22.73	—12.91
1917	10.40	+ 7.2	— 0.75	9.65	193	18.62	19.01	— 0.39	11.26	— 0.81	10.45	20.17	+ 1.16
1918	10.40	+ 10.5	— 1.09	9.31	204	18.99	12.97	+ 6.02	11.62	— 1.22	10.40	21.22	+ 8.25
1919	10.40	— 30.9	+ 3.21	13.61	220	29.94	30.09	— 0.15	10.18	+ 3.15	13.33	29.33	— 0.76
1920	10.40	+ 77.1	— 8.02	2.38	236	5.62	7.00	— 1.38	10.65	— 8.21	2.44	5.76	— 1.24
1921	10.40	— 36.9	+ 3.84	14.24	145	20.65	25.00	— 4.35	10.37	+ 3.83	14.20	20.59	— 4.41
1922	10.40	+ 12.9	— 1.34	9.06	158	14.31	8.00	+ 6.31	11.04	— 1.42	9.62	15.20	+ 7.20
1923	10.40	— 86.1	+ 8.95	19.35	153	29.61	12.00	+17.61	11.15	+ 9.60	20.75	31.75	+19.75

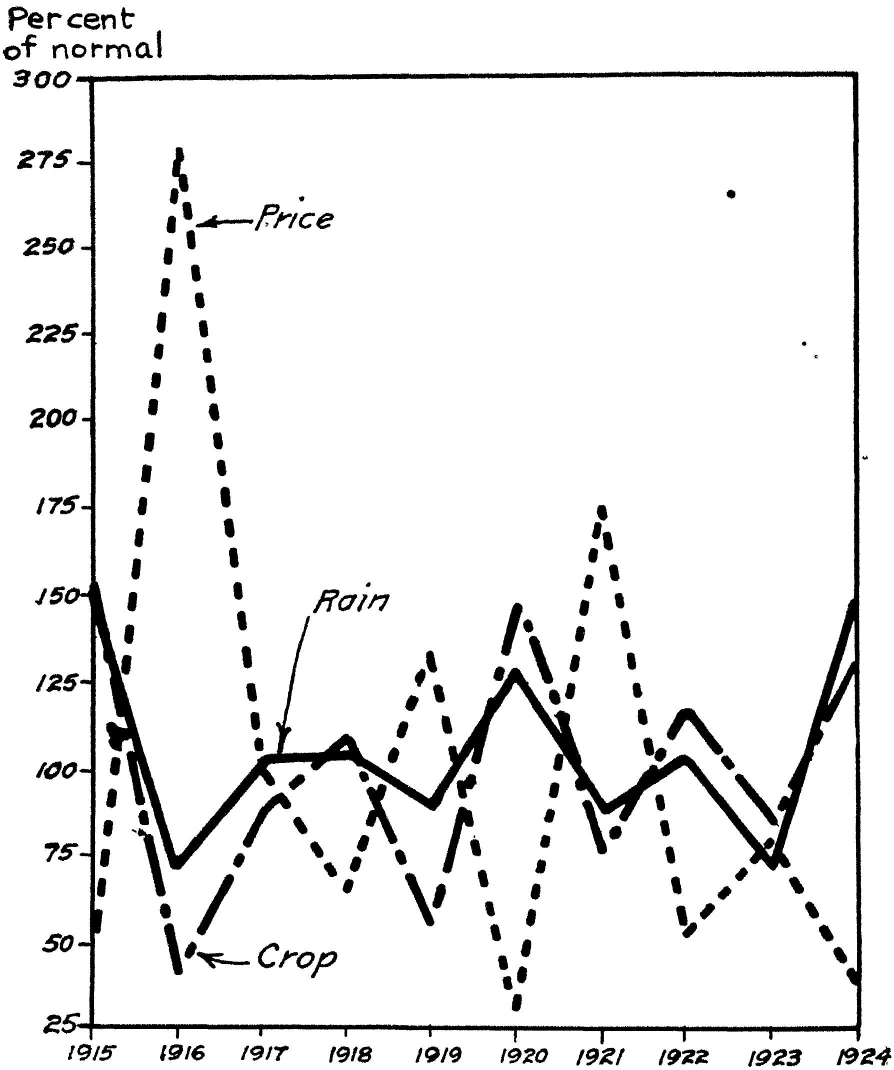


FIGURE 27. CORRELATION BETWEEN RAINFALL, TOTAL TONS OF CABBAGE PRODUCED IN NEW YORK STATE, AND NOVEMBER PRICE FOR CABBAGE TO GROWERS AT LITTLE YORK

The prices paid to growers, as corrected for the general price level by dividing the actual price by the monthly index number of wholesale prices in the United States, are shown in table 70. By presenting the data in this form, the figures for different years are comparable.

One cannot expect a formula to reflect the adjustment necessary for very unusual situations such as the extreme abandonment of acreage in 1916 because of a dry July, for violent variations in the distribution of rainfall, or for panics. If one corrects the results for the abandonment of acreage, which was reported as 29 per cent for New York in 1916, the

TABLE 70. AVERAGE MONTHLY PRICES PAID TO FARMERS FOR WHITE DANISH CABBAGE AT LITTLE YORK, CORRECTED FOR PRICE LEVEL

(Same years as in table 58)

Rainfall, in per cent of normal	Number of years	October	November	December	January	February	March	Simple average
	Prices to growers per ton, corrected for price level							
Less than 90	11	$12.00	$12.47	$19.75	$23.08	$21.74	$21.84	$18.48
90 to 110	8	8.52	8.24	10.65	12.58	18.25	17.97	12.70
More than 110	9	5.39	5.96	9.35	11.70	11.49	14.94	9.80
Average	......	$8.88	$9.17	$13.81	$16.42	$17.45	$18.52	$14.04
	Seasonal variations, six-months average = 100							
Less than 90	11	65	67	107	125	118	118	100
90 to 110	8	67	65	84	99	144	141	100
More than 110	9	55	61	96	119	117	152	100
Average	......	63	65	99	117	124	132	100

formula predicts the actual price for 1916. Neither can one expect a formula to predict the price within the range of difference between the yield as forecast by the United States Department of Agriculture on October 1, and the final report on yield. In 1916 the forecast of yield on October 1 was 4.4 tons per acre for New York, and the final report was 5.4 tons. Such a difference in forecasts would result in a higher price in November than would be predicted from the rainfall or would be justified by the production. The price predicted by the use of this formula must always be considered a preliminary approximation, to be adjusted for things that cannot be expressed in the formula, such as: (1) Panics, general or agricultural. (2) Abandonment of acreage planted; the abandonment of some of the acreage grown, because of too low a fall price, would also affect the seasonal price. (3) Violent variations in the distribution of rainfall, such as are shown in table 19. (4) Too high or too low September and October forecasts of production, as published by the United States Department of Agriculture. (5) Bearish sentiment among buyers, which would keep the price below what the state production would justify. (6) Bullish sentiment among producers, especially in a year of very short crop. In many years, however, such influences as all of these are so small that they need no consideration.

In applying the formula, it is considered that cabbage would not be sold for less than $3 a ton in the earlier years, or $4 a ton in later years. In years of very heavy rainfall, when a minus price is predicted, this minimum price at which it is considered cabbage would be marketed is used. The writer has often heard growers state that one year of low prices and one year of average prices prevail for every year of a double price.

The succeeding changes in price level make a revision of the corrected price necessary about every ten years. The average of the November prices for the ten years from 1894 to 1903, inclusive, corrected for price level, was $6.83; the average for the ten years from 1904 to 1913, inclusive, was $9.94; and that for the ten years from 1914 to 1923, inclusive, was $10.40. The average for the past two years has been $6.45. It is possible that it will be necessary to shift to a lower constant than $10.40 during the coming years of decreased prices and of decreased purchasing power

of farm products. Also, the United States price level for farm products may be used, the purpose being to have comparable index numbers for thirty years. The correction for the secular trend for the entire period in the purchasing power of the November price is only 13 cents a ton. Rather than to attempt to get a constant to apply for thirty years, it is better to get a new one every ten years as this simplifies the formula and is more satisfactory.

Based on past behavior, the chances of an extremely dry July in the New York cabbage district are for one year in fifteen; of an extremely dry August, for one year in four; and of an extremely dry September, for one year in eight. The chances of an extremely wet July (40 per cent or more above normal rainfall) are for one year in eight; of an extremely wet August, for one year in five; and of an extremely wet September, for one year in four. The variation in rainfall is greatest in August, next greatest in July, and least in September. The two most critical months for cabbage are July, when the plants are starting, and September, when the crop is putting on weight. Extreme drought in either month results in a low yield per acre. The chances of either occurring are small, but when they do occur, the price may be expected to be high.

The number of years of various combinations of seasons, and the chances of such seasons based on a thirty-years period, which is somewhat short, are shown in table 71.

TABLE 71. YEARS WITH, AND PROBABILITY OF, VARIOUS KINDS OF SEASONS

Season	Very dry	Dry	About normal	Wet	Very wet	Extremely wet
	Per cent of normal rainfall					
	60 or less	From 61 to 90	From 91 to 110	From 111 to 125	From 126 to 140	More than 140
	Number of years					
July	2	13	6	3	2	4
August	7	7	6	2	2	6
September	4	11	4	1	3	7
July and August	0	1	2	0	0	1
July and September	0	4	0	0	0	2
August and September	1	4	2	0	0	1
July, August, and September	0	0	0	0	0	1
	Based on this record, the chances are for 1 year in					
July	15	2	5	10	15	8
August	4	4	5	15	15	5
September	8	3	8	30	10	4
July and August	0	30	15	0	0	30
July and September	0	8	0	0	0	15
August and September	30	8	15	0	0	30
July, August, and September	0	0	0	0	0	30

The relation of various combinations of rainfall to prices is shown in table 72. Only two or three years of each combination indicated in this table have occurred during the past thirty years. The droughty September is more often accompanied by high fall prices and a larger increase in the March price over the November price than any other situation.

TABLE 72. RELATION OF VARIOUS COMBINATIONS OF RAINFALL TO PRICES OF CABBAGE PAID TO GROWERS AT LITTLE YORK

	Per cent of normal			Increase in March price over November price	
	Total rain in July, August, and September	Rain for month in question	November price	Actual price	Corrected for price level
Years of heavy total rainfall but low September rainfall					
1903	118	54	145	$29	$33
1905	111	65	126	17	19
Average	114	60	136	$23	$26
Years of light rainfall in all months					
1913	71	71	168	0	0
1909	76	76	100	$12	$12
1899	79	79	137	8	10
Average	75	75	135	$7	$7
Years of low August and September, but high July, rainfall					
1897:					
Season	83	....	54	$ 3	$ 4
August	....	54	....	....	....
September	....	61	....	....	....
1900:					
Season	89	....	68	6	7
August	....	77	....	....	....
September	....	64	....	....	....
1908:					
Season	78	....	229	11	12
August	....	58	....	....	....
September	....	44	....	....	....
Average:					
Season	83	....	117	$7	$8
August	....	63	....	....	....
September	....	56	....	....	....
Years of about normal total rainfall, but low July and August rainfall					
1918:					
Season	104	....	70	$13	$ 6
July	....	79	....	....	....
August	....	65	....	....	....

TABLE 72 (*concluded*)

	Per cent of normal			Increase in March price over November price	
	Total rain in July, August, and September	Rain for month in question	November price	Actual price	Corrected for price level
Years of about normal total rainfall, but low July and August rainfall (*concluded*)					
1894:					
Season	92	....	73	7	10
July	....	75	....	....	....
August	....	41	....	....	....
Average:					
Season	98	....	72	$10	$8
July	....	77	....	....	....
August	....	53	....	....	....
Years of heavy total rainfall, but low August rainfall					
1904	123	88	64	$ 7	$ 8
1902	120	74	30	2	2
1896	126	92	46	12	18
Average	123	85	43	$7	$9
Years of heavy total rainfall, but low July rainfall					
1898	121	63	47	0	0
1912	115	82	44	-$1	-$1
Average	118	72	46	0	0
Years of heavy rainfall for all months					
1915	151	151	42	$5	$5
1920	126	126	33	- 2	- 1
Average	138	138	38	$2	$2

APPLICATION OF THE FORMULA FOR PREDICTING PRICE

The ten-years average November price, corrected for price level, to be used next year would be $10.40. The average corrected price for the past two years has been only $6.45. It is possible that until more complete adjustment between prices for farm products, and general prices, and a fuller establishment of confidence on the part of the buyers, are brought about, a ten-years average will predict a price higher than will prevail.

Growers and buyers should watch more closely the reports on the acreage planted and the condition of the cabbage. If the prices of farm

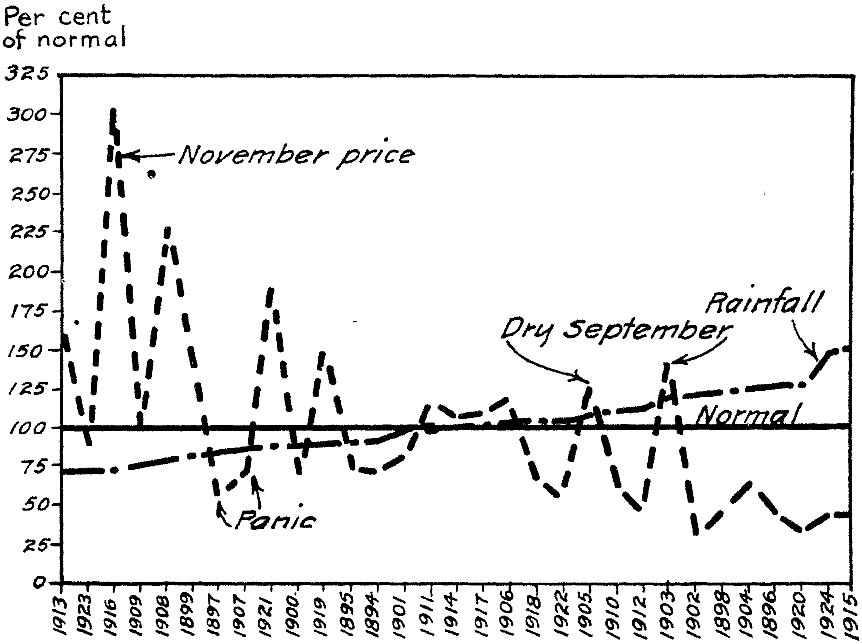


FIGURE 28. NOVEMBER PRICES PAID TO GROWERS AT LITTLE YORK, FOR WHITE DANISH CABBAGE

(Years arranged from least to largest amount of rainfall in July, August, and September)

products had not been suffering from an agricultural depression, the price to growers would have been higher in both 1922 and 1923, as the seasonal trend indicated it should be. The normal seasonal trend for cabbage is to double in price from October to March. In the season of 1922, the price to growers rose from \$8 to \$55 a ton, and in the season of 1923 from \$12 to \$40. This seems to indicate that the fall price was too low. A light southern crop in 1922 had, of course, some influence on this rise in price. A fair fall price to the producer is in the interest of everybody. If the price is below what the size of the crop justifies, cabbage that will be needed later in the season is fed to animals.

If cabbage is to maintain the same purchasing power that it has had for the past ten years, if the general price level remains the same as this year, and if the rainfall is 75 per cent of the normal next season, unless other unusual factors occur, the November price might be expected to be approximately \$28 a ton, according to the formula:

November price = 153 × \$10.40 + (\$10.40 × 3 × 25), or \$27.85 a ton.

If the rainfall is 125 per cent of normal, the forecast price would be approximately \$4 a ton, according to the formula:

November price = 153 × \$10.40 − (\$10.40 × 3 × 25), or \$3.98 a ton.

The actual price in a year of heavy rainfall would probably be the minimum price at which farmers would sell cabbage (about \$7 a ton)

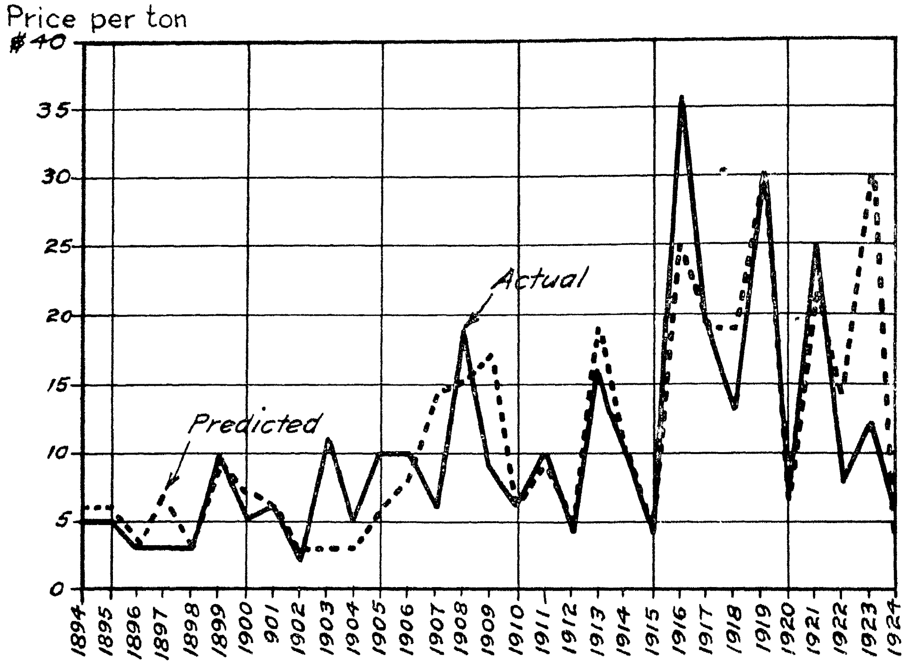


FIGURE 29. COMPARISON OF THE NOVEMBER PRICES PAID TO GROWERS AT LITTLE YORK, AS PREDICTED FROM RAINFALL, WITH THE ACTUAL PRICES RECEIVED

and not feed it to animals unless some circumstance made the crop short. In 1924, the rainfall was 148 per cent of normal and the November price was $6 a ton. In justice to the producer, the price should be higher than this in order to reward him for the service of furnishing the crop; but actually, in very wet years it is seldom higher than the least he will accept for it, which is almost always very little above the cost of marketing.

The market situation is not so simple that any one set of conditions may be expected to reflect with certainty the tendencies of the price. The acreage, production, and earliness of the season for the southern crop, as well as the amount and quality of Danish to be marketed, the movement of the crop, and the price of cabbage relative to that of other vegetables, will determine the trend of late cabbage prices. To approximately discount the effect on price, of abnormalities in any one or all of these phases of the situation, requires paying systematic attention to forecasts of production, receipts on the markets, weather conditions, and current prices.

THE NEW YORK MARKET

Late or Danish cabbage is delivered in New York City in the Wallabout Yards, Brooklyn, in the Bronx Produce Yards on the Harlem River, in the New York Central yards at West Thirty-third Street, and in the Lehigh Valley yards at West Twenty-seventh Street. Most of it arrives in bulk car-lots. The railroads do not deliver bulk cabbage on the docks, but a

small amount of sacked cabbage is delivered on the New York Central pier at Barclay Street. At the other terminal points, the cabbage is sold chiefly in bulk wagonloads or in 100-pound sacks. Most of the early southern crop arrives on the Pennsylvania piers or on the adjoining Old Dominion Steamship Company piers. It is sold mostly by commission men on the day it is unloaded from the floats, and must be removed that day altho the Pennsylvania piers have a heated room for emergency use. The fact that the docks must be cleared daily results in low prices when the demand is slow and the supply liberal, and occasionally only transportation costs are obtained. Often this situation is not understood by shippers; but it cannot be prevented by the commission merchants, whose business is to dispose of the produce, not to cart it from the docks and hold it until prices advance.

During the season from September to December there is very little activity on the piers that receive cabbage from southern shipping districts, as the demand at that time is supplied by up-state Danish cabbage. During the months when Danish is out of season, the activity in the chief receiving terminals for this crop is lessened, with recurring activity on piers receiving the southern crop.

The crop is usually purchased at country shipping points, for cash, from farmers by local buyers, who either store it themselves to be shipped later, sell on consignment, sell thru a broker, or ship to a commission merchant. Scarcely any farmers ship on their own account. Occasionally a buyer merely acts as agent for some firm whose chief business is the handling of cabbage.

Most of the business pertaining to the marketing of late cabbage is on a joint-account basis. By this arrangement the country buyer purchases the cabbage, gets the car ready, and loads it. The buyer charges the cabbage at the amount paid to the farmer, the freight is paid, and the difference between these costs and the amount received for the cabbage is divided equally between the two partners. No charge is made to the city-end partner for loading at the shipping point, because the cabbage must be unloaded at the other end and it is considered that these costs balance.

The joint-account arrangement provides an incentive for the seller to get the most for the cabbage, and for this reason that method is more generally used. The commission merchants and brokers are interested in selling as many cars as possible, regardless of the market situation. The joint-account men are more cautious when the market is dull, and do not encourage shipping. This operates to the advantage of the producer in accordance with a well-established market principle, "Never encourage a dull market to be poorer."

The Produce Reporter Company, of Chicago, Illinois, publishes a credit book which may be rented at a certain amount per annum. The producers, shippers, merchants, and receivers are listed by State, village, and county, and are rated according to their reputation in business. This is a useful book for concerns doing a large business. The State Department of Farms and Markets at Albany publishes a list of licensed and bonded commission merchants. For 1923, this is Circular 246. The protection

of the state law, which gives the Department authority to collect the amount due the shipper in case of nonpayment, applies to sales on commission only. Authority from the buyer to the dealer to purchase produce on his own account, or any agreement between the two for sale of goods other than on a commission basis, deprives the Department of authority to collect.

The early crops of cabbage are grown chiefly in Florida, Texas, and California. If the data for all years are complete, the production and the shipments from early-producing areas and from the intermediate districts of South Carolina and Virginia have been steadily increasing. The New York City demand for car-lot cabbage is supplied almost exclusively by Florida, South Carolina, Virginia, and New York, the last-named State furnishing, in addition to the product trucked in from Long Island and other areas close to the city, from one-fourth to one-third of the yearly car-lot unloads in the city. The car-lot movement of the Florida crop begins in volume in February, just after the New York storehouses are emptied, and continues thru April. In April the South Carolina crop is ready, and this moves in volume during April and particularly in May. The Virginia and Maryland crop is ready for June, July, and August, and this completes the chronology of the supply side, bringing consumption around to the New York crop.

The cabbage crops that compete most with the crop from New York State, in city markets, are the late southern crop, the New Jersey and

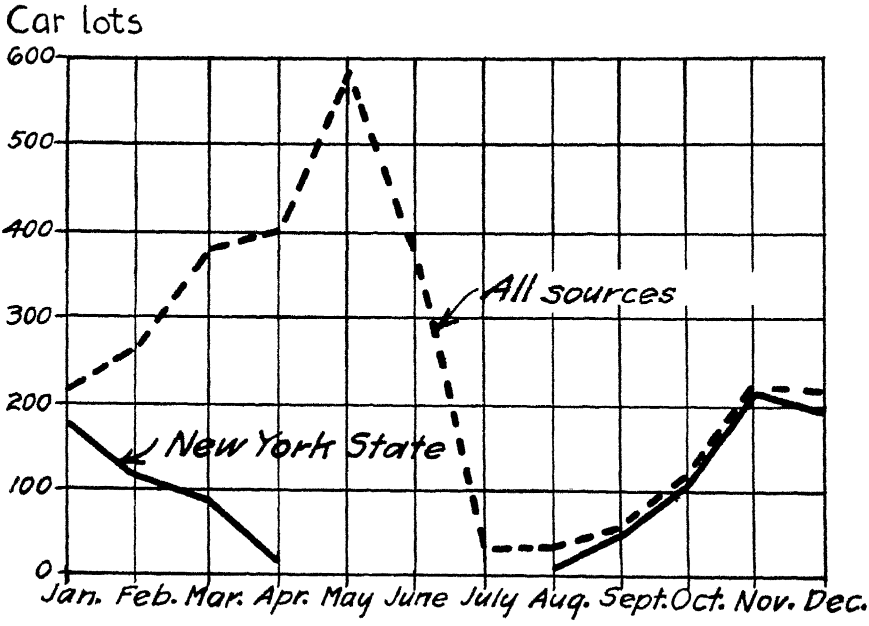


FIGURE 30. COMPARISON OF CAR-LOT UNLOADS OF CABBAGE IN NEW YORK CITY ORIGINATING FROM ALL SOURCES AND FROM NEW YORK STATE

(Six-years average, 1918–1923)

Long Island crop (which, arriving in September, weakens the market for New York domestic cabbage), the Wisconsin crop (which keeps the New York crop principally out of the Chicago, St. Louis, Cincinnati, and such disseminated markets), and the early Florida crop, especially in favorable years when it begins to arrive before the up-state stored cabbage has all been unloaded. All this competition must be reckoned with in considering the question of storage.

The packages used in the shipment of cabbage, and the number of packages per car, are approximately as shown in table 73:

TABLE 73. KINDS OF CABBAGE CONTAINERS*

	Number of packages or weight, per car	
	Range	Approximate usual
Barrels from 100 to 110 pounds (Long Island, New York, New Jersey, and Norfolk section of Virginia)	200–250	200
Bulk (late cabbage States)	24,000–30,000	25,000
Crates:		
Atlantic Coast type (12 x 18 x 33), from 100 to 125 pounds	200–220	210
Mississippi Valley type (16 x 16 x 28), from 100 to 125 pounds	200–220	210
Colorado type (21 x 22 x 24), from 140 to 175 pounds	160–180	....
California type (18 x 18 x 23¾)	180–210	200
Texas type (20 x 20 x 25), from 150 to 200 pounds	132–175	150
Pony (12 x 18 x 22), 60 pounds	....	400
Hampers, 1½ bushels, approximately 50 pounds (Florida and Tennessee)	425–550	....

* United States Bureau of Agricultural Economics, Form F. V. 33. Revised December 15, 1922.

UNLOADS BY ORIGINATING DISTRICTS

The car-lot unloads of cabbage in New York City, by originating districts and by months for six years, are shown in table 74. The percentage of the total car lots furnished by the State, including Long Island, was as follows: in 1918, 33; in 1919, 34; in 1920, 22; in 1921, 34; in 1922, 37; and in 1923, 38. The car lots from different States do not fairly represent the amount of edible product, because of the large amount of containers in carloads from the South.

July and August are vacation months for New Yorkers. The consumption of cabbage in the city is less in those months, and the demand is supplied by the Long Island and New Jersey crops. Thus there are practically no arrivals of car lots in those months (table 75). The car-lot unloads of cabbage in New York City are heaviest in March, April, and May. This crop comes from the southern States. During July, August, and September no carloads reach the city. Some cabbage is trucked in from June until Christmas. Beginning in October the carloads arrive in increasing numbers, and this continues till May.

TABLE 74. UNLOADS OF CABBAGE IN NEW YORK CITY, BY ORIGINATING DISTRICTS AND BY MONTHS, FROM 1918 TO 1923
(Car lots and boat receipts reduced to car-lot equivalents)

Originating district	Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
New York, including Long Island	1918	177	136	137	43	...	...			25	92	191	161	962
	1919	182	160	156	29	...	...	...	...	5	46	99	104	781
	1920	94	48	38	6	...					35	204	91	516
	1921*	164	101	92	20	...	...		9	73	136	182	256	1,033
	1922†	219	104	63	16	...	...	...	...	17	148	336	316	1,219
	1923‡	224	143	142	3	...	...		10	163	251	338	237	1,511
Florida	1918	11	121	249	331	102				...		...	3	817
	1919	23	60	140	140	28	5			...	...	...	2	398
	1920	23	142	276	456	110	...		...			...	...	1,007
	1921	31	113	198	14	...	...	...		...		...	1	357
	1922	58	197	369	107	...	...					...	5	736
	1923	27	70	139	56	3	...	...	...	...		...	9	304
South Carolina	1918	...	...	...	97	362	1			...	...			460
	1919	...	...	...	111	211	1	...	...		...			323
	1920	...	1	...	10	267	101				...	...	...	379
	1921	23	44	130	467	67	3	...					1	735
	1922	...	6	25	253	320	2	...				...	1	607
	1923	22	17	30	362	467	1			...		...	19	918
Virginia	1918	2	...	1	...	284	268	1		...	1		...	557
	1919	...	...	...	2	325	282	3				...		612
	1920	...	...	...	...	11	206	9				...	...	226
	1921	...	...	...	25	516	246	...	17	5	...		7	816
	1922	1		...	...	331	245				...	...	...	577
	1923	1	...	1	...	232	455	4	103	47	...	...	9	852
Maryland	1918	...	...	...	...	...	4		...	...		...		4
	1919	...	...	...	...	...	72		...	...	...	...	...	72
	1920	...	...	...	...	...	1	3		1	...	...		5
	1921	...	...	...	...	...	23	...	...		...	...		23
	1922	...	...	...	...	...	96	1			...	...		97
	1923	...	...	...	...	...	52	10	...			...	...	62
New Jersey	1918	...	1	...	...	...	27	37		...	1	3	...	69
	1919	1	1	1	...	...	29	23	2	1	5	6	4	73
	1920	1	1	...	...	...	16	16	1	...	...	1	...	36
	1921	...	...	...	...	...	...	...	...	...	...	...	...	...
	1922	...	...	...	...	...	...	...	...	...	...	...	...	...
	1923	...	...	...	...	...	...	...	...	...	...	...	...	...

Imports	1918	......	......	......	......	......	......	......	......	......	......	......	......	......
	1919	......	......	......	......	......	......	......	......	......	......	......	......	......
	1920	......	......	......	......	......	......	......	......	......	......	......	......	......
	1921	......	......	......	......	......	......	......	......	......	......	......	59	59
	1922	12	47	......	......	......	......	......	......	......	......	......	1	60
	1923	29	32	100	57	13	......	......	......	1	10	......	......	242
All others	1918	......	1	......	......	10	......	......	......	......	......	......	......	11
	1919	......	6	10	9	6	4	......	......	1	......	......	4	40
	1920	11	5	5	10	102	3	......	......	......	1	......	......	137
	1921	......	1	1	2	1	......	......	1	1	......	......	......	7
	1922	......	5	5	21	5	1	......	......	......	......	......	......	37
	1923	4	4	24	2	7	7	6	31	6	......	1	......	92
Total	1918	190	259	387	471	758	300	38	......	25	94	194	164	2,880
	1919	206	227	307	291	570	393	26	2	7	51	105	114	2,299
	1920	129	197	319	482	490	327	28	1	1	36	205	91	2,306
	1921	218	259	421	528	584	272	......	27	79	136	182	324	3,030
	1922	290	359	462	397	656	344	1	......	17	148	336	323	3,333
	1923	307	266	436	480	722	515	20	144	217	261	339	274	3,981

* Additional 53 cars freight and express LCLS.
† Additional 65 cars freight and express LCLS.
‡ Additional 101 cars freight and express LCLS.

TABLE 75. CAR-LOT UNLOADS OF CABBAGE IN NEW YORK CITY*

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total for year
1916	131	229	367	435	271	193	51	10	5	97	149	132	2,070
1917	†	1†	19†	102	244	591	122	3	63	371	292	219	2,027†
1918	190	259	387	471	758	300	38	...	25	94	194	164	2,880
1919	207	227	308	291	571	393	26	2	7	51	104	114	2,301
1920	129	197	319	482	490	327	28	1	1	36	205	91	2,306
1921	218	259	421	528	584	272	0	27	79	136	182	324	3,030
1922	290	359	462	397	656	344	1	0	17	148	336	323	3,333
1923	307	266	436	480	722	515	20	144	217	261	341	274	3,983

* Data for the years 1916 to 1920 are from the United States Department of Agriculture, Bul. 982, p. 243, 1920; for 1921 to 1922, from a report of the United States Bureau of Agricultural Economics by C. H. Brown, Rochester, New York; and for 1923, from a report of the Bureau of Agricultural Economics to October.
† Reports incomplete.

PLACE OF ARRIVAL

The numbers of carloads of cabbage delivered each year, during the period from 1918 to 1923, by the Delaware, Lackawanna & Western Railroad at the Wallabout Terminal in Brooklyn, have been as follows: in 1918, 438; in 1919, 364; in 1920, 372; in 1921, 505; in 1922, 467; in 1923, 683 (table 76). During the same period, only 41 cars were transferred to the Harlem Yards.

TABLE 76. CAR-LOT MONTHLY UNLOADS OF CABBAGE DELIVERED BY THE DELAWARE, LACKAWANNA & WESTERN RAILROAD AT WALLABOUT TERMINAL, NEW YORK

Month	Carloads in each year					
	1918	1919	1920	1921	1922	1923
January	57	84	66	108	68	74
February	52	60	25	65	44	55
March	41	47	32	41	22	40
April	26	12	6	10	7	...
May	.....	.....	.....	.....	.....	.....
June	.....	.....	.....	.....	.....	.....
July	.....	.....	.....	.....	.....	.....
August	.....	.....	.....	7	.....	34
September	13	12	..	37	12	99
October	63	13	32	69	47	136
November	96	66	126	80	135	145
December	90	70	85	88	132	100
Total	438	364	372	505	467	683

The number of carloads of cabbage delivered at the Bushwick Terminal, by months for six years, has been furnished by Mr. Donald Wilson, general freight agent of the Long Island Railroad Company, as shown in table 77. The carloads delivered by the New York Central Railroad are shown in tables 78 and 79.

TABLE 77. CARLOADS OF CABBAGE DELIVERED AT BUSHWICK TERMINAL

	1918	1919	1920	1921	1922	1923
January	12	27	13	25	21	5
February	0	9	4	18	15	5
March	4	16	1	18	7	1
April	0	2	1	9	3	0
May	.....	.....	.....	.....	.....	.....
June	.....	.....	.....	.....	.....	.....
July	.....	.....	.....	.....	.....	.....
August	.....	.....	.....	.....	.....	.....
September	4	3	0	2	0	1
October	42	24	11	19	5	4
November	33	33	41	36	22	20
December	42	20	18	15	20	22
Total	137	134	89	142	93	58

TABLE 78. MONTHLY CAR-LOT UNLOADS OF CABBAGE DELIVERED BY THE NEW YORK CENTRAL RAILROAD AT WEST THIRTY-THIRD STREET YARD, NEW YORK

	1921*	1922	1923
January	78	55	42
February	48	27	32
March	58	30	21
April	33	15	3
May	9	8	1
June	0	0	0
July	0	0	0
August	5	0	6
September	41	20	24
October	49	35	29
November	80	86	81
December	70	44	36
Total	471	320	275

* Information for the years prior to 1921 for the West Thirty-third Street yard is not available.

TABLE 79. CAR-LOT UNLOADS OF CABBAGE DELIVERED BY THE NEW YORK CENTRAL RAILROAD TO NEW YORK

Destination	1918	1919	1920	1921	1922	1923
West One Hundred and Thirtieth Street	6	3	4	None	None	None
Barclay Street	15	26	21	10	20	44
Westchester Avenue	7	7	7	7	7	1
West Thirty-third Street	......	......	.....	471	320	275

WHOLESALE PRICES OF CABBAGE IN NEW YORK CITY

The averages of the high and the low Saturday quotations in the *Producers' Price-Current* have been taken as the monthly wholesale prices of Danish, domestic, and red cabbage in New York City.

LATE CABBAGE

Before the fall of 1899, cabbage prices were reported as so much per 100 heads, and not according to tons. Using an average weight of 5 pounds per head, the writer has calculated a price per ton for each of the six years preceding 1899, so that the city prices of Danish cabbage for thirty years are available and nearly complete for the months from November to March, inclusive. This figure for weight is merely an estimate, however, formed according to the average weight of cabbage shipped from Little York, and the prices per ton that are used for these earlier years must be interpreted with this in mind. They are probably a little too high. (Tables 80 and 81.)

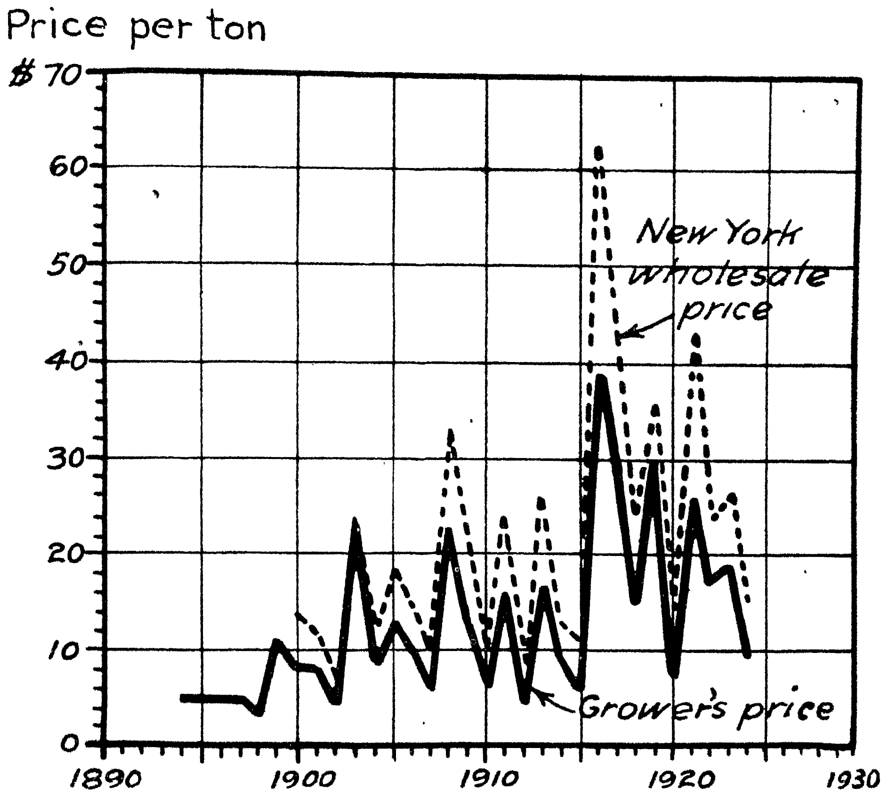


FIGURE 31. AVERAGE SEASONAL PRICES RECEIVED BY GROWERS FOR CABBAGE AT LITTLE YORK, COMPARED WITH THE AVERAGE NEW YORK WHOLESALE PRICES EACH YEAR

(Weighted according to monthly shipments sent by F. N. Salisbury)

TABLE 80. AVERAGE MONTHLY WHOLESALE PRICES OF DANISH CABBAGE PER TON, IN NEW YORK CITY

Year	October	November	December	January	February	March	April	May
	Prices per ton assuming weight at 5 pounds per head							
1894–95..	$11.52	$12.24	$12.40	$18.00	$26 48	$44.00	$39.32	......
1895–96..	12.00	11.60	13.00	23.52	20.40	28.68	......	......
1896–97..	9.60	10.48	11.00	26.00	18.48	12.00	......	......
1897–98..	12.48	12.00	8.88	7.88	7.24	7.00	9.00	......
1898–99..	9.20	8.48	11.40	12.00	22.00	28.00	52.00	......
1899–1900	10.48	11.76	18.76	27.00	......	......	......	......
	Ton prices as reported in *Producers' Price-Current*							
1899–1900	......	......	......	......	$ 23.00	$33.30	$ 35.00	$35.00
1900–01..	......	$13.50	$13.20	$ 15.25	14.00	15.60	13.00	......
1901–02..	......	......	10.88	10.75	16.62	15.40	19.88	20.00
1902–03..	$ 7.68	6.83	11.12	9.10	7.38	6.00	8.62	6.50

TABLE 80 (*concluded*)

Year	October	November	December	January	February	March	April	May
	Ton prices as reported in *Producers' Price-Current* (*concluded*)							
1903–04..	$12 70	$15.00	$34 12	$ 31 50	$ 45.62	$46.56	$ 47.50	......
1904–05.	... ..	11.33	11.50	12.12	11 62	16 00	12.00	$ 7.00
1905–06..	......	17 50	20.10	20.38	18 50	32.20	37.50	......
1906–07..	13.50	13 00	12.90	15 38	21 00	18.62	9.62	10.75
1907–08..	. ....	8.60	10.50	10 38	10.50	9.38	8.88	......
1908–09..	19 90	21 12	29.00	32 40	37.75	41.25	......	......
1909–10..	13.50	11 62	15.80	28 12	27.00	24.62	30.00	......
1910–11..	10.25	10 00	12 90	9 88	10.00	9.38	10.00	5.00
1911–12..	11 62	15.62	21.60	25 50	33.88	48.33	54.17	......
1912–13..	10.00	7.70	6.50	7.50	7.12	8.00	8.75	13.75
1913–14..	21.50	19.70	26.00	28.12	25.00	25.00	24.50	......
1914–15..	12 87	8.38	11.50	14.50	11.75	13.62	28.75	22 50
1915–16..	7 50	6 00	7 88	9 62	8.87	14.67	... ..	.. ...
1916–17..	.... .	46.62	54.50	103.75	130 00	.. . .	......	......
1917–18..	31.00	24 62	38.50	45.62	58.12	24.50	22.50	......
1918–19..	19.38	17 10	22.25	25.88	23.12	42.50	112.50	......
1919–20..	28.00	31.67	68 75	87.00	71.88	77.50	75.00	......
1920–21.	......	......	12.50	15 88	13.62	14.50	18.10	10.00
1921–22..	30.62	36.50	47.40	49.88	38.00	37.38	.. ...	......
1922–23..	20.50	13 00	21.10	24.00	35.62	42.00	31.00	......
1923–24..	21 88	16 88	23 88	29.00	37.62	44.12	. ....	......
1924–25..	11 00	14 40	12.83	21.50	15.50	12.17	13 00	......

TABLE 81. AVERAGE MONTHLY WHOLESALE PRICES OF RED CABBAGE PER TON, IN NEW YORK CITY

Year	October	November	December	January	February	March	April	May
1902–03..	......	$ 7.33	$13.62	$ 13.30	$12.12	$ 9.38	......	......
1903–04..	......	......	44.17	38.50	46.25	47.50	......	......
1904–05..	. ....	......	31.67	28.75	27.50	33.12	$ 25.00	......
1905–06..	.. ...	23.25	24.40	21.88	17.75	19.70	......	......
1906–07..	......	......	......	25.83	34.38	40.83	......	......
1907–08..	......	......	......	18.33	15.70	14.62	13.50	......
1908–09..	......	30.50	35.62	37.50*	37.50*	47.50*	......	......
1909–10..	. ....	22.50	25.80	34.50	29.12	35.00	26.25	......
1910–11..	$22.50	26 25	34.50	31 25	32.50	.. ...	......	......
1911–12..	19 00	19.75	24.70	23.88	24.50	29.17	28.33	......
1912–13..	......	16.67	16 00	16.00	15.38	14.50	8.50	......
1913–14..	26 25	22.20	31 00	28 75	25.38*	25.75*	......	......
1914–15..	......	......	......	28.33	39.38	45.00	......	.. ...
1915–16..	......	9.75	24.44	21.62	23.62	25.00	24.00	$25.00
1916–17..	......	......	......	......	......	......	......	......
1917–18..	......	......	......	......	......	......	......	......
1918–19..	......	......	......	96.67	90.00	96.67	162.50	......
1919–20..	......	......	......	111.00	88.75*	75.00*	......	......
1920–21..	......	......	......	20.62	18.75	15.75	20.25	......
1921–22..	......	......	59.69	59.38	62.50	63.12	......	......
1922–23..	......	21.50*	42.00*	45.00	......	......	......	......
1923–24..	37.00	29.00	......	......	90.00	......	......	......
1924–25..	......	36.50	33.75	......	......	......	......	......

*State red cabbage.

When the prices per ton that were taken from the *Producers' Price-Current* are compared with the prices quoted in the *New York Journal of Commerce*, no significant differences are noted between the two sets of data.

The price of red cabbage usually ranges from $5 to $20 a ton above that of white cabbage. In only one year of these records, 1911, was the price of red cabbage below that of white, and in one year, 1918, it was about $70 a ton higher than that of white. Only small quantities of red cabbage are used. The average monthly wholesale prices per barrel are shown in table 82:

TABLE 82. AVERAGE MONTHLY WHOLESALE PRICES OF RED CABBAGE PER BARREL, IN NEW YORK CITY

Year	August	September	October	November	December	January	February	March	April	May
1896–97...	...	...	...	...	$0.61	$0.68	.	..	...	...
1897–98...	...	...	$1.00	$0.82	0.82	0.96	$1.17	$1.25	...	...
1898–99...	...	...	...	...	...	...	..	...	...	...
1899–1900,	.	..	...	...	...	...	...		...	
1900–01...		.	...	...	...	...	...	...	...	..
1901–02..	...	...	...	...	...	...	...		...	...
1902–03...	...	...	...	...	...	1.12	1.16	1.12	...	..
1903–04...	...	...	..	...	...	..	..		..	...
1904–05...	..	.	...	..	...	...	..	...	...	..
1905–06...	...	.	...	...	...	...	..	...	...	
1906–07...	...	.	.	...	...	...	...	.	.	..
1907–08...	...		1.21	1.22	1.31	1.38	1.30	1.09	$1.12	...
1908–09..	$1.12	$1.12	1.18	1.38	2.19	2.45	2.38	2.75	.	..
1909–10...	...		0.88	1.03	1.28	1.84	1.88	1.88	1.75	..
1910–11...	...	..	2.12	2.18	2.20	2.08	2.38	.	3.25	...
1911–12...	...	.	1.18	1.25	1.54	1.66	1.62	1.88	1.78	.
1912–13...	...		..	0.98	0.88	...	.	..	..	...
1913–14...	...	2.00	1.66	1.26	1.69	1.84	1.70*	1.75	...	
1914–15...	...	..	1.75	1.75	1.38	1.83	2.69	3.00	4.50	$2.50
1915–16...	0.88	1.03	0.95	0.91	1.41	1.31	1.56	1.75	1.88	2.00
1916–17...	...	...	2.50	2.88	2.75	5.50	6.50	7.50	...	..
1917–18...	...	1.25	2.03	2.44	3.30	4.44	6.00	..	..	..
1918–19...	2.00	1.75	1.66	2.55	3.44	5.62	5.00	5.95	8.88	..
1919–20...	...	...	2.58	3.00	3.75	6.15	4.81*	4.03*	3.38*	4.00
1920–21...	...	1.41	1.40	1.50	1.41	1.44	1.25	1.22	1.48	1.75*
1921–22...	...	...	3.54	3.25	4.40	4.62	4.53	4.67	...	...
1922–23...	...	1.88*	1.94*	1.88*	3.62	3.56	3.28	3.00	...	...
1923–24...	.	..	2.12	1.92	1.95	2.38	2.88	3.78	..	...
1924–25...	1.50	1.28	1.66	1.82	1.88	2.53	1.99	2.53	2.62	...

* State red cabbage.

The normal or average seasonal trend for the price of cabbage is to double from October to March (figure 32). In a year of very short crop the seasonal advance is much greater than this, and in a year of very large crop it is much less, there sometimes not being sufficient advance to cover storage costs. In a year of a very large cabbage crop, it usually does not pay to hold the cabbage. In a year of a very small crop, holding usually pays well. Some persons who make a business of holding cabbage do not pay enough attention to governmental reports to know whether the crop is large or small, or how big it is, but store cabbage every year. A statement commonly made is that in order to be sure of a rise in price, the only safe way is to store the crop every year. This is not altogether true. While the size of the late crop is generally indicative of the course which the prices are to take thruout the season, it is not invariably so, because of the probability of a large or a small Florida crop, which

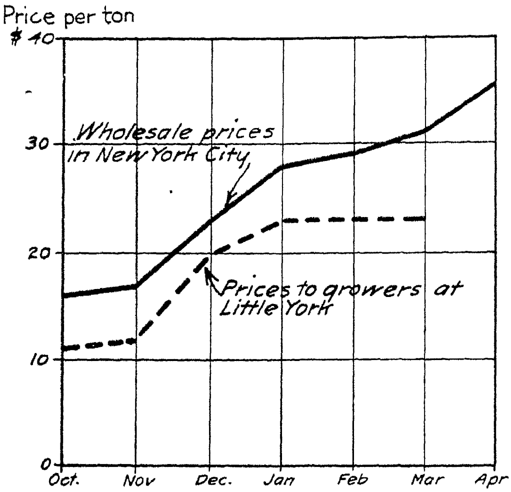


FIGURE 32. AVERAGE MONTHLY PRICES FOR DANISH CABBAGE PAID TO FARMERS AT LITTLE YORK, AND WHOLESALE PRICES PAID AT NEW YORK

(Twenty-two seasons, 1900 to 1921 inclusive)

affects prices in February and March. Of the nine years from 1915 to 1923, the years 1915, 1918, 1920, and 1922, were those in which the crops were largest.

A produce and feed dealer who stores cabbage year after year said to the writer, "You can make out your tables, they are all right; but I will fill my house every year." He cited the experience of 1922 as an example of the dealer's inability to determine when there might be an opportunity to make money on stored cabbage.

A comparison of the simple average prices paid to farmers at Little York for the twenty-two seasons from 1900 to 1921, with the simple average wholesale prices in New York City for the same years, shows that the spread between the two prices was less in December than in any of the other six months of the late cabbage season. It has already been noted that shipments usually fall off in December. Circumstances that may account for the narrow margin in that month are: (1) that shipments from the fields have ceased; (2) that farmers and storehouse operators have just got their crops well stored; (3) that the season is early, and neither the farmers nor the storehouse operators are eager to move their holdings because they know that, by delaying, the price will advance sooner, and that prices are usually better later in the season; (4) that storehouse operators also wish to pay as good prices to farmers in December as they possibly can, to induce them to move their holdings, so that later in the season the competition will be less and a better spread between shipping point and city prices can be obtained for their own holdings. The shippers are able to maintain a wider spread in October and November for late cabbage because the shipments are heavier at that time; and from January to March because in the latter month the storage season ends and the farmers are compelled to sell.

When the price tendencies of the past thirty years are summarized, it is seen that in about seven years there was decided gain in holding cabbage. These were 1903, 1905, 1908, 1911, 1916, 1919, and 1922. Of the remaining years, 1902, 1904, 1907, 1910, 1912, 1914, and 1915 would show a decided loss in holding, as in these years the price advanced but very little or declined. For the remaining years, the fluctuations in price were variable. In some of these years, considerable money was made on cabbage that was disposed of at the right time. In others, the market broke, and supplies in storage had to be disposed of at a heavy

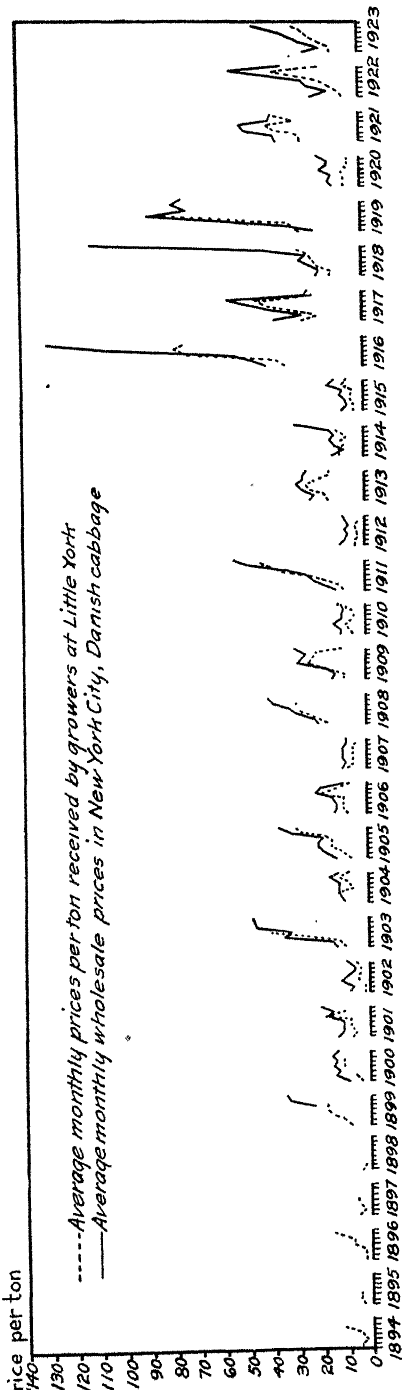


FIGURE 33. AVERAGE MONTHLY PRICES PER TON RECEIVED BY GROWERS AT LITTLE YORK, AND MONTHLY WHOLESALE PRICES IN NEW YORK CITY FOR DANISH CABBAGE

loss. A graphic review of the seasonal changes in the price paid to growers at Little York, and the average monthly wholesale price of cabbage in New York City for Danish cabbage, is given in figure 33.

The extreme fluctuations in the wholesale prices of cabbage in New York City, and consequently in shipping-point prices, are an excellent example of the kind of marketing which results from the inability of producers to perform the service of storage and to cooperate in an equalized feeding of the market. For example, in 1919 the unloads of cabbage in New York were 2301 cars. The average wholesale price for the year was \$69. In 1920, the unloads were 2306 cars, and the average price was \$15, or one-fourth as much as in 1919. The consumption of cabbage varies little, but the price varies widely. The difference in wholesale value of the same amount of cabbage in two succeeding years was about \$1,500,000. It should be recognized, of course, that the deflation of agriculture was well begun in 1920, and part of the difference in price may have been due to the depression that prevailed in the fall of 1920.

The difference between the wholesale price of cabbage in New York City and the prices paid to the farmer represents the margin for performing the services and assuming the risks of storing the crop in order to provide a distribution that meets the demand. If the producer chooses to own storage facilities, either individually or cooperatively, he must also assume the risks that go with the business. Not until greater storage facilities are provided will there be any steadiness in the price of cabbage. The price must be expected to be generally high when the crop is short and generally low when the crop is large, and to go higher as the shipping season advances, the advance being greater when the crop is short.

The weighted average seasonal price received for Danish cabbage by growers selling at Little York for the twenty-eight years from 1894 to 1921, found by dividing the receipts by the number of tons sold, was \$12.72 a ton. The range was from \$3.25 to twelve times as much, or \$38.81 a ton (table 83). There were fourteen years in which the price was less, and fourteen years in which it was more, than \$9 a ton. The September cabbage, all domestic, is omitted from these calculations.

TABLE 83. TOTAL AMOUNTS OF WHITE CABBAGE PURCHASED BY ONE FIRM AT LITTLE YORK, AND AVERAGE PRICES PAID

Year	Tons of Danish and domestic cabbage	Amounts paid to farmers	Average prices per ton, including domestic cabbage	Average prices per ton, excluding September purchases*
1894–95	1,181.5	\$ 5,478	\$ 4.64	\$ 4.64
1895–96	697.5	3,184	4.56	4.56
1896–97	590.9	2,914	4.93	4.93
1897–98	485.0	2,363	4.87	4.87
1898–99	395.4	1,456	3.68	3.25
1899–1900	492.6	5,294	10.75	10.75
1900–01	573.8	4,832	8.42	8.49
1901–02	1,352.0	11,151	8.25	8.37
1902–03	429.6	1,857	4.32	4.32
1903–04	361.7	8,414	23.26	23.26
1904–05	406.1	3,075	7.57	7.66
1905–06	604.2	7,530	12.46	13.10
1906–07	1,521.8	14,579	9.58	10.12

TABLE 83 (*concluded*)

Year	Tons of Danish and domestic cabbage	Amounts paid to farmers	Average prices per ton, including domestic cabbage	Average prices per ton, excluding September purchases*
1907–08	927 9	$ 5,820	$ 6 27	$ 6 23
1908–09	765 1	17,046	22 28	22 84
1909–10	1,530 4	19,251	12 58	12 93
1910–11	2,358.2	13,698	5.81	5.82
1911–12	1.539 0	24,629	16 00	16 27
1912–13	1,306 1	5,270	4 03	4 09
1913–14	1,329 5	22,749	17 11	17 06
1914–15	1,682 0	15,627	9 29	9 43
1915–16	984 2	4,920	5 00	5.00
1916–17	699.4	26,923	38 49	38 81
1917–18	1,621.9	45,647	28 14	28 72
1918–19	1,355 3	19,630	14 48	14 68
1919–20	873 6	26,486	30 32	30.33
1920–21	1,086 2	7,450	6 86	6 86
1921–22	1,023.6	26,847	26 23	26.34

* This pertains almost entirely to Danish stock, altho small quantities of domestic were included in October. It may be taken as the weighted seasonal price paid to growers for Danish cabbage.

The weighted average seasonal wholesale price of Danish cabbage in New York City for these same twenty-eight years found by applying the monthly prices that prevailed at the time of purchase from the farmer, to the cabbage purchased by this same firm at Little York, was $17.26, or $4.54 more than the growers received. Freight charges and other costs

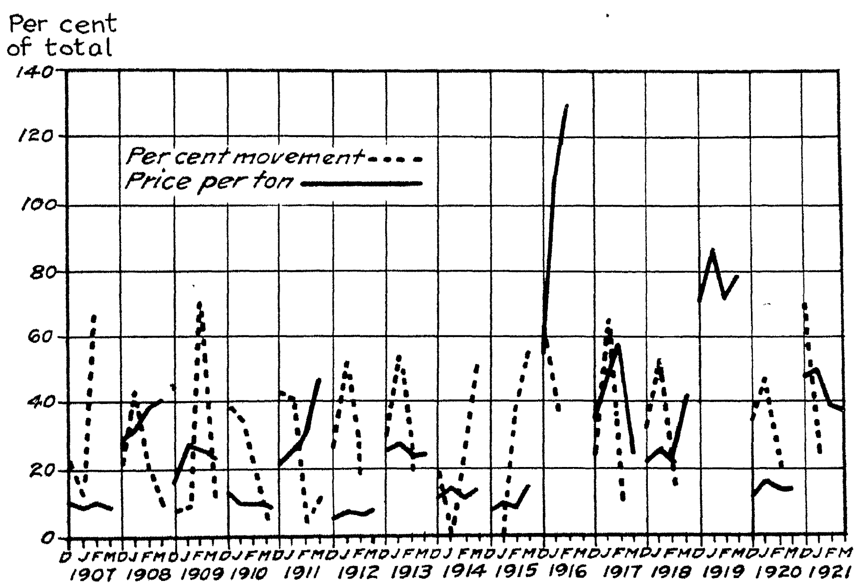


FIGURE 34. RELATION OF THE ANNUAL SEASONAL TREND OF THE NEW YORK WHOLESALE PRICE OF CABBAGE, TO THE MOVEMENT FROM STORAGE AT LITTLE YORK

of handling at the country shipping points, and in the wholesaler's hands, come out of this. This same price, found by applying the monthly prices that prevailed at the time of shipping the cabbage shipped by this same firm, was $19.60, or $6.88 more than the growers received (table 84).

TABLE 84. COMPARISON OF SEASONAL PRICES PAID TO GROWERS FOR WHITE CABBAGE AT LITTLE YORK, WITH AVERAGE WHOLESALE NEW YORK PRICES

Season	Average prices per ton paid to growers	Average New York wholesale prices as cabbage was purchased	Amounts per ton above or below prices received by growers	Average New York wholesale prices as cabbage was shipped	Amounts per ton above prices received by growers
1894–95	$ 4.64	$13.50	$8.86	$13.50	$ 8.86
1895–96	4.56	12.00	7.44	12.00	7.44
1896–97	4.93	13.76	8.83	13.76	8.83
1897–98	4.87	10.46	5.59	10.46	5.59
1898–99	3.25	8.76	5.51	8.76	5.51
1899–1900	10.75	13.94	3.19	13.94	3.19
1900–01	8.49	13.35	4.86	13.59	5.10
1901–02	8.37	12.34	3.97	12.21	3.84
1902–03	4.32	8.30	3.98	8.30	3.98
1903–04	23.26	23.47	0.21	23.47	0.21
1904–05	7.66	12.05	4.39	12.05	4.39
1905–06	13.10	18.61	5.51	18.79	5.69
1906–07	10.12	9.14	– 0.98	14.52	4.40
1907–08	6.23	5.72	– 0.51	10.22	3.99
1908–09	22.84	24.81	1.97	32.74	9.90
1909–10	12.93	16.61	3.68	22.82	9.89
1910–11	5.82	10.23	4.41	10.47	4.65
1911–12	16.27	18.96	2.69	24.20	7.93
1912–13	4.09	9.30	5.21	8.18	4.09
1913–14	17.06	23.40	6.34	25.50	8.44
1914–15	9 43	12.17	2.74	12.86	3.43
1915–16	5.00	8.42	3.42	10.77	5.77
1916–17	38.81	47.51	8.70	63.45	24.64
1917–18	28.72	36.52	7.80	40.89	12.17
1918–19	14.68	21.45	6.77	23.58	8.90
1919–20	30.33	27.48	– 2.85	36.11	5.78
1920–21	6.86	13.05	6.19	13.61	6.75
1921–22	26.34	36.10	9.76	42.93	16.59
Weighted average	$12.72	$17.26	$4.54	$19.60	$6.88
Simple average	$12.63	$17.19	$4.56	$19.77	$7.14
Simple average for last twelve years	$16.95	$22.05	$5.10	$26.05	$9.10

Cabbage is usually sold thru a broker f.o.b. shipping point, or on a joint account between the shipper and the wholesaler in the city. Since up-state cabbage is almost never sold on a commission basis, the result is a narrow range of prices based almost entirely on differences in quality. Prices at different shipping points are generally fairly uniform. The

cost to the jobber is thus fixed, and at any day is not widely different from the cost to competing jobbers. Cars of bulk stock on the track can be held at slight demurrage costs, or they can be stored in the warehouse at Harlem for a few days, unless the weather is too warm. The price of New York cabbage is not influenced by a daily clearance of the dock, as is the price of southern stock. The result of this is that, if arrivals of bulk stock are short of market needs, an active demand increases jobbing prices; and increased jobbing prices stimulate shipments, which on arrival are held, if not too heavy, until prices are sufficiently high for a profit. At the same time shippers are told by their joint-account city jobbing partners to decrease the shipments, the price falls for a time, and the process is repeated. Prices of products sold chiefly on a commission basis, especially of stock unloaded on the docks, cannot be held so firmly against a slow market, for the products are usually sold at whatever price can be obtained. However, this does not imply that reasonable effort is not made to obtain all that the product will bring.

Some shippers prefer to do business by telephone, subject to letter confirmation, rather than by wire or by letter alone, as they are often able to infer from the tone of voice and the attitude in conversation in response to acute questioning, the degree of activity of the present market, and whether the city buyer anticipates a strong, a sharply rising, a dull, or a slumping market.

It is sometimes said that a good price when the market is very likely to fall is an encouragement to load the car fuller than when prospects for an increase in price are favorable. However, there is very little business done on this principle, and what exists should be discouraged.

Bullish information stimulates the market price, but lowers consumption, which in turn lowers the price again. It also increases the desire to store the crop and thus bulls the price further.

EARLY CABBAGE

Florida

Until 1908 the wholesale quotations in New York City for Florida cabbage were by the barrel crate and usually appeared from February until April (table 85). Since then they have been made mostly on a crate basis, and quotations in January have been more common than in earlier

TABLE 85. AVERAGE MONTHLY WHOLESALE PRICES FOR FLORIDA CABBAGE IN NEW YORK CITY FROM 1894 TO 1925

Year	Price per barrel crate				
	January	February	March	April	May
1894	$2.00	$1.38	$1.25	$1.10	....
1895*	....	....	3.12	5.50	$3.50
1896	....	2.12†	2.56†	2.53	1.34
1897	1.38	1.34	1.09	1.88	....
1898	....	1.06	1.12	1.25	0.75
1899	....	....	2.29	4.00‡	....
1900	....	2.25	2.65	2.75	1.59
1901	....	1.92	1.75	2.22	1.79
1902	....	1.38	1.48	2.28	1.62
1903	....	....	1.19†	1.44	....

TABLE 85 (*concluded*)

Year	Price per barrel crate				
	January	February	March	April	May
1904		$3 00	$3 09	$3.16	$1.25
1905	...	1.25	1 53	1.62	...
1906	...	1 88	2 35	1.97	1 25
1907	...	...	2 48†	...	...
1908‡	...	1 66†	1 44†	1 38†	...
1909‡	$1 83	1 97	2.47	2.38	...
1910	...	1 97†	1 94†	2.58†‡	1 50‡
1911†‡	...	1 56	1 75	0 94	...
1912†‡	2 50	2 88	3 35	3.25	2.00
1913†‡	...	1.00	1 25	...	...
1914‡	2.21	1.50	2 00	1 62	...
1915‡	1 69	1.88	1.88	2.88	2.33
1916†‡	...	1 69	2 19	...	...
1917‡	4 25	4.97	4 55	6 75	5.03
1918	...	2.04‡	1 68	2.25	1.18
1919†‡	...	3 19†	4 03†	6 69†	3 90
1920†	4 50‡	3 62‡	5.31	3.06	...
1921‡	2.38	2 31	2 31	1.56	...
1922‡	3.25	1.83	1 75	2.38	...
1923‡	3 88	3.83	...	...	...
1924‡	2 50	2 88	3 35	3 12	...
1925	2.25§	2.12‡	2 12‡	...	...

* Per barrel. † New cabbage. ‡ Per crate. § Per basket.

years. This probably indicates a tendency for the crop to reach the market earlier than it did before. The high prices which have prevailed during the past seven years have made it possible for the Florida grower to realize a substantial profit on his crop.

The price of Florida cabbage in New York City depends chiefly on two conditions: (1) how large the Florida crop is (figure 35); and (2) how plentiful is the supply of up-state Danish stock from storage.

The Florida cabbage that comes into the New York market in competition with the late Danish crop from New York State must bear extra freight and refrigeration charges. This is about $17.80 a ton for freight and $70 a car for refrigeration. The cost of the labor in unloading the crop in the city, and of the sacks saved, will offset about half of the cost of hampers. The Florida growers have no holding charges to pay, and this amounts to from $6 to $7 a ton for Danish cabbage. The price equations thus become:

Florida costs = hampers + extra freight + refrigeration.

Up-state Danish costs = holding charge + sacks + extra labor in unloading in the city.

When the consumption of new cabbage begins, old cabbage becomes less desired. The tenderness and palatability of new southern cabbage naturally gives it an advantage in the market over the old crop. Also, it is packaged, and is thus in a more convenient form for distribution and handling in the many places where cabbage is retailed. The higher price that can therefore be obtained for new cabbage makes up for the greater cost of transportation.

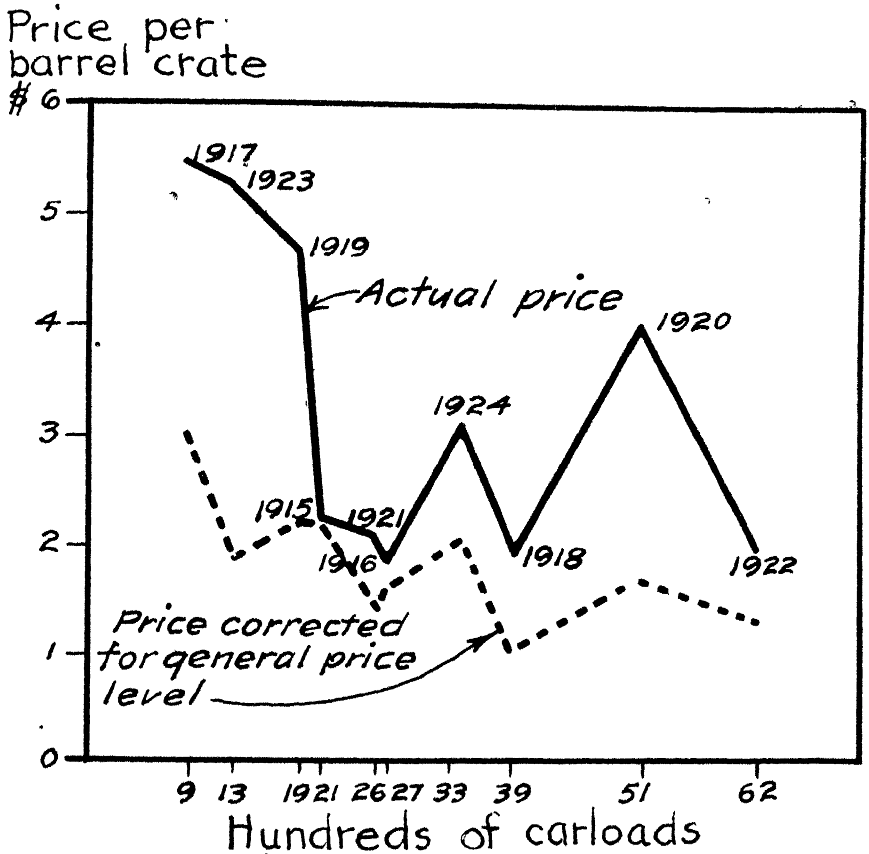


FIGURE 35. RELATION OF THE SIZE OF THE FLORIDA CROP TO THE AVERAGE FEBRUARY, MARCH, AND APRIL WHOLESALE PRICE OF FLORIDA CABBAGE IN NEW YORK CITY

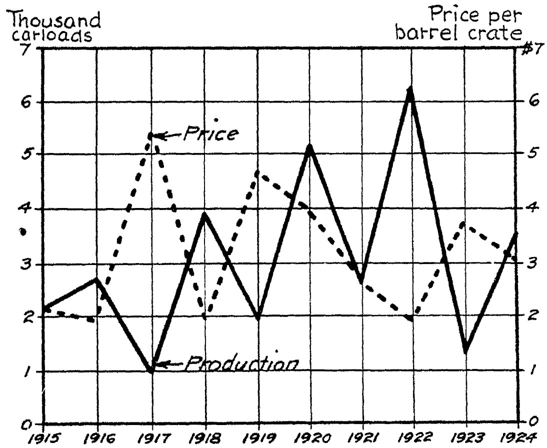


FIGURE 36. RELATION OF THE PRODUCTION OF FLORIDA CABBAGE TO THE WHOLESALE PRICE OF FLORIDA CABBAGE IN NEW YORK CITY

In years when the production of late cabbage in the northern States is neither extremely high nor extremely low, the price of Florida cabbage in New York City varies inversely with the size of the Florida crop. A large Florida crop commands low prices, and vice versa. When the northern crop is short, as it was in 1919, good prices can be realized for Florida cabbage, almost regardless of the size of the crop, as was the

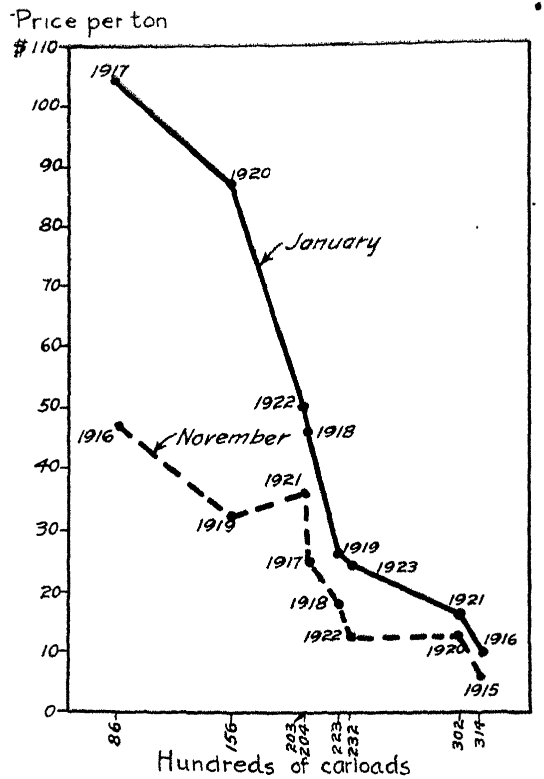


FIGURE 37. RELATION OF THE SIZE OF CROP IN NEW YORK STATE AND FLORIDA, TO THE NOVEMBER AND JANUARY WHOLESALE PRICES OF DANISH CABBAGE IN NEW YORK CITY

When the combined New York and Florida crop is small, the difference between the November and January prices is much greater than when only the New York crop is small

case in February, March, and April, 1920. When both the northern crop and the Florida crop are short, as they were in the season of 1916–17, the price of Florida cabbage can be expected to go extremely high, as it did in 1917. These relationships are shown in figure 36.

The arrival of cabbage from Holland and other countries always causes more uneasiness in the market than the amount imported justifies. The same is probably true of reports on the condition and the size of the early southern crop as affecting the prices of New York Danish cabbage in November and December.

Carolina

The price for Carolina cabbage has been most frequently quoted in April and May, by barrels until 1907 and by crates since then. This crop supplies the market from one to two months later than does the Florida cabbage. Its average price in New York City in April and May bears the same relation to the size of the crop in Carolina as the price of Florida cabbage bears to its size of crop (table 86). This relation is shown in figure 38. The Carolina and the Florida production have each doubled in the past nine years. The production of Florida cabbage is characterized by alternate heavy and light crops, and reference to tables 1 and 2 indicates that this is a matter of variation in acreage, more than of yields per acre; but the Carolina production does not show such decided variation. So eager are the South Carolina growers to get their cabbage on the market before the price declines, that they are likely to ship it before the heads are solid.

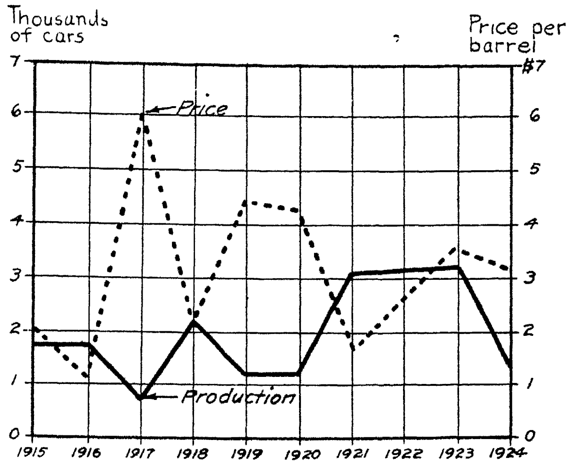


FIGURE 38. RELATION OF THE PRODUCTION OF SOUTH CAROLINA CABBAGE TO THE WHOLESALE PRICE OF CAROLINA CABBAGE IN NEW YORK CITY

TABLE 86. AVERAGE MONTHLY WHOLESALE PRICES IN NEW YORK CITY FOR CAROLINA CABBAGE, MAINLY FROM CHARLESTON AND OTHER PARTS OF SOUTH CAROLINA, FROM 1894 TO 1925

Year	Price per barrel or crate					
	January	February	March	April	May	June
1894	....	....	$1.00	$1.36	$1.11	....
1895	....	....	....	....	3.28	....
1896	....	....	....	2.62	1.98	....
1897	....	....	1.38	2.25	....	....
1898	....	....	....	1.32	0.71	....
1899	....	....	....	3.00	2.38	$2.25
1900*	....	....	2.58	3.19	2.12	0.75
1901	....	....	1.81	2.28	1.66	....
1902	....	....	....	2.08	1.54	....
1903	....	....	1.19	1.88	1.09	....
1904	....	....	....	2.56	1.50	2.25
1905	....	....	....	1.92†	1.00*	0.58*
1906	....	....	2.56	1.78	2.06	....
1907*	....	....	....	2.12	2.06	....
1908*	....	....	....	1.42†	1.19	....
1909	....	....	2.44*	2.38*	0.67	....
1910*	....	....	1.94	2.48	1.21	....

TABLE 86 (*concluded*)

Year	Price per barrel or crate					
	January	February	March	April	May	June
1911*†	....	$1 62*†	$1.78*†	$1.09*	....	....
1912*†	....	....	....	2.69	$1.52	....
1913	$0.98*†	0.95*	1 06*†	1.50‡	1.14‡	....
1914*	2 08	1.56	....	1.41	1.25	$1.25
1915*	1.62	1.56	2.75	2 56	1 58	....
1916*	1 16	0.99	1 25	1 12	....	....
1917*	4 00	....	....	....	6 06	2.12
1918*	....	....	....	2 92	1.25	1.12
1919*†	....	....	....	5 25	3 72	....
1920*	....	....	....	4.50	4.02	2.66
1921*	2 04	1.88	1.81	1 62	1.62	....
1922*	....	....	1.62	2 69	....	....
1923*	....	....	....	4 56	2.58	....
1924*	....	....	....	3 38	2.94	....
1925*	2.38	....	....	1.31	2 62	....

* Per crate. † New cabbage. ‡ Per barrel.

Virginia

Quotations of prices for Virginia cabbage are confined chiefly to May and June, being given on a per-barrel basis solely until 1908, and on a per-crate basis also since then. The prices per crate are a few cents higher than the prices per barrel, as the cabbage is of slightly better quality

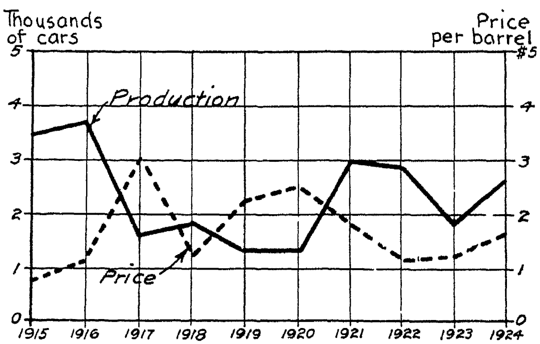


FIGURE 39. RELATION OF THE PRODUCTION OF VIRGINIA (NORFOLK, EASTERN SHORE) CABBAGE TO THE WHOLESALE PRICE OF VIRGINIA CABBAGE IN NEW YORK CITY

and the package is easier to handle. The production from the eastern-shore district of Virginia appears to have increased in 1917, 1918, 1919, and 1920. The price of Virginia cabbage in New York City bears the same relation to size of crop as do the prices for the crops from other areas (table 87 and figure 39).

TABLE 87. AVERAGE MONTHLY WHOLESALE PRICES FOR VIRGINIA CABBAGE IN NEW YORK CITY FROM 1894 TO 1925

Year	Price per barrel		Price per crate*	
	May	June	May	June
1894	$1 12	$1 38	....	....
1895	1.69	0.86	....	....
1896	1.20	0.69	....	....
1897	0.79	0.97	....	....
1898	0.59	0.45	....	....
1899	2.56	1.83	....	....
1900	1.88	0 78	....	....
1901	1.02	0.70	....	....
1902*	1 22	1.16	....	....
1903	0 97	1 16	....	....
1904*	2.12	1 78	....	....
1905	1 17	0 46	....	....
1906	1 69	1.12	....	....
1907	1 88	1 17	....	....
1908	0 62	0.35	$0 68	$0.43
1909	0 56	0.41	0 68	0 39
1910	0.99	0.38	0.95	0.40
1911	1 29	1.39	1.75	1 56
1912	0.98	1.00	1 10	1.05
1913	0 97	1 02	1 04	1.22
1914	0.79	0.63	0.88	0.68
1915	1.23	0 25	1.25	0.29
1916	1.17	0 91	1.69	1 12
1917	4.54	1.50	5.25	1.78
1918	0.89	1 52	1.00	1.70
1919	2.97	1.56	3.78	1.81
1920	1.88	3.16	3.08	3.41
1921	1.97	1.62	2 22	1.91
1922	....	....	1 41	0.72
1923	....	....	1.19	1.21
1924	....	....	2 29	0.90
1925	....	....	2.35	....

* Per barrel crate.

Long Island and New Jersey

The separation of the Long Island production from the remainder of the New York production was not made until 1920; therefore, prior to that year, no study of the relation of the size of the New Jersey and Long Island crop to the price can be made. Since this is the chief source of supply for the New York City market in early fall, a decided opposite relation of price to size of crop is to be expected. The few years' data that are available show that this situation actually occurs, as is indicated in table 88. With the high freight rates that now prevail, the Long Island grower has more advantage over the up-state producer of early cabbage for the New York City trade than he had formerly. Prices for domestic cabbage have been higher in recent years, altho highly variable from year to year.

As an average for the twenty-two years from 1900 to 1921, Florida cabbage sold in New York City on a continuously advancing market because of the increasing shortage of up-state Danish as the season

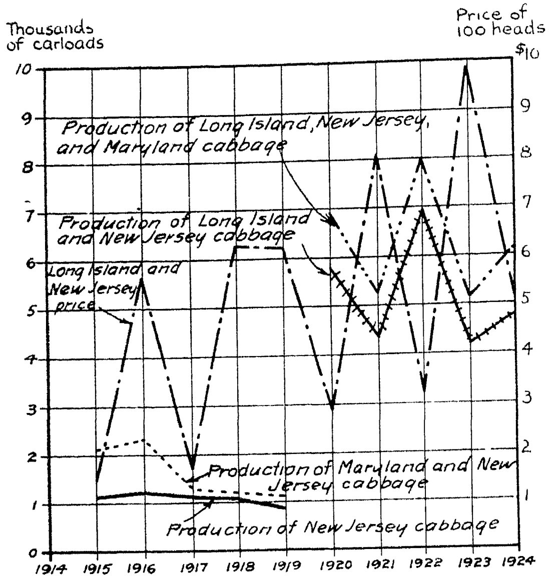


FIGURE 40. COMPARISON OF THE PRODUCTION OF DOMESTIC CABBAGE AND THE WHOLESALE PRICE RECEIVED IN NEW YORK CITY

(Information for Long Island was not available prior to 1920)

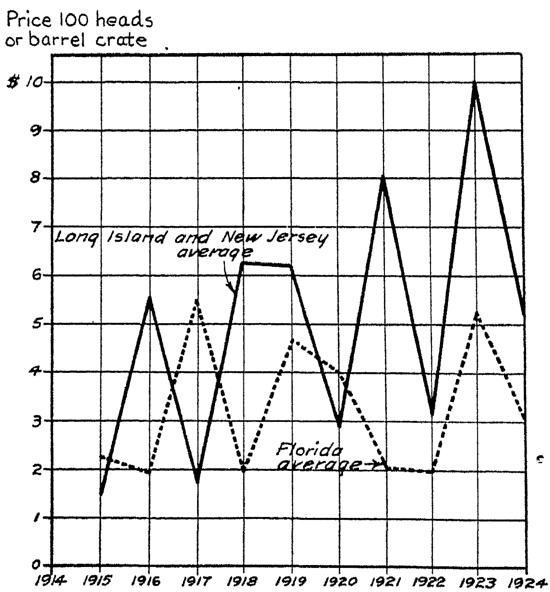


FIGURE 41. RELATION OF THE AVERAGE WHOLESALE PRICE IN NEW YORK CITY FOR LONG ISLAND AND NEW JERSEY CABBAGE IN JULY, AUGUST, AND SEPTEMBER, TO THE PRICE FOR FLORIDA CABBAGE IN

TABLE 88. AVERAGE MONTHLY WHOLESALE PRICES OF CABBAGE IN NEW YORK CITY

Year	Long Island, or New Jersey and Long Island							
	Price per 100 heads				Price per barrel			
	July	August	September	October	July	August	September	October
1894	$3.44	$6.12	$5.45	$4.12	......	......	......	......
1895	1.88	1.42	......	3.00	......	......	......	......
1896	3.00	2.55	2.75	......	......	......	......	......
1897	2.62	2.38	3.19	3.90	......	......	......	......
1898	3.60	2.38	2.75	......	......	......	......	......
1899	3.30	2.69	2.80	2.62	......	......	......	......
1900	1.53	2.12	2.12	2.25	......	......	......	......
1901	3.34	4.10	4.12	3.25	......	......	......	......
1902	2.75	2.40	2.58	1.92	......	......	......	......
1903	5.31	6.50	4.25	4.80	......	......	......	......
1904	2.38	1.50	2.33	2.50	$0.56	$0.39	$0.67	......
1905	3.35	5.00	3.80†	3.31†	0.94	1.25	......	......
1906	2.94	2.62	3.40	3.50	0.75	0.75	......	......
1907	3.17	5.10†	5.00†	......	0.83	......	......	......
1908	5.17*†	5.10*†	5.50*†	4.70†	0.88*	0.90*	......	......
1909	3.69‡	2.25‡	2.38‡	2.65‡	1.00	0.94	......	......
1910	2.75*	5.94	3.75	......	0.57*	0.88*	0.88*	......
1911	6.17†	5.00†	......	......	1.08*	......	......	......
1912	4.50	4.50	......	......	0.91*	0.92*	......	......
1913	5.00	6.10	6.25‡	6.62‡	1.09	1.09	......	......
1914*	2.38	2.30	2.62	3.00	0.68	0.42	0.61	$0.88
1915	1.25	1.38*	1.75‡	......	0.28*	0.25*	......	......
1916	4.50†	4.75†	7.50†	8.50†	0.70*	1.22*	1.62*	1.75*
1917	2.00	1.50	......	......	0.58	0.38	......	......
1918*	7.38	6.50	5.00	3.94	1.38	1.25	1.25	......
1919	7.17	5.80	5.62	5.50	1.62	1.38	1.34	1.38
1920	4.70	1.94	2.00	2.00	1.44	0.69	0.75	0.78
1921	2.83*	11.50‡	9.88‡	......	1.12*	3.25‡	2.47‡	1.85‡
1922	2.48	4.12‡	3.00‡	......	1.08*	1.00	1.02	1.12
1923	......	......	......	......	......	......	......	......
1924	......	......	......	......	......	......	......	......

* Near by. † Flat Dutch. ‡ Cabbages.

advanced. The Carolina and the Virginia cabbage sold on a continuously declining market. The prices for the Long Island and New Jersey cabbage experienced no important advance or decline as the season progressed, but White Danish stock doubled in price from October to March (table 89). This general tendency did not hold true for each year, however, for crops from any area.

The average seasonal trend in wholesale prices for the years 1900 to 1921, inclusive, in New York City, for Long Island and New Jersey, White Danish, Florida, South Carolina, and Virginia cabbage, is indicated in figure 42. Prices for Long Island and New Jersey cabbage and for White Danish cabbage normally do not advance until the last of November. The price for Florida cabbage is equal to the price for White Danish plus

TABLE 89. COMPARISON OF AVERAGE WHOLESALE PRICES OF FLORIDA, CAROLINA, VIRGINIA, LONG ISLAND AND NEW JERSEY, WHITE DANISH, AND RED CABBAGE IN NEW YORK CITY, FROM 1900 TO 1921 INCLUSIVE
(All on a ton basis)

Type of cabbage	January	February	March	April	May	June	July	August	September	October	November	December
Florida	...	$42 60	$47 00	$51.80	...	...			...	...	...	...
Carolina	...	...	...	52 40	$36 20	...	...	...	...	...	...	...
Virginia	...	...	...	...	29 80	$21 80		...	...	...	...	...
Long Island and New Jersey	...	...	...	...	...	...	$15 32	$17 08	$16 44	...	...	...
White Danish	$27.66	29 01	30 50	34 63	...	...	...	...	...	$16 35	$16.73	$22.70
Red cabbage*	42.74	44 55	43 25	...	...	...	...	...		...	...	39 82

* Data for the years 1902 to 1921 inclusive, only.

the difference in transportation from Florida to New York City and from western New York to New York City. The Florida cabbage sells on a constantly advancing market. The South Carolina and the Virginia crops are sold on a normally declining market. At the time of year when this cabbage comes on the market, there is an abundance of lettuce,

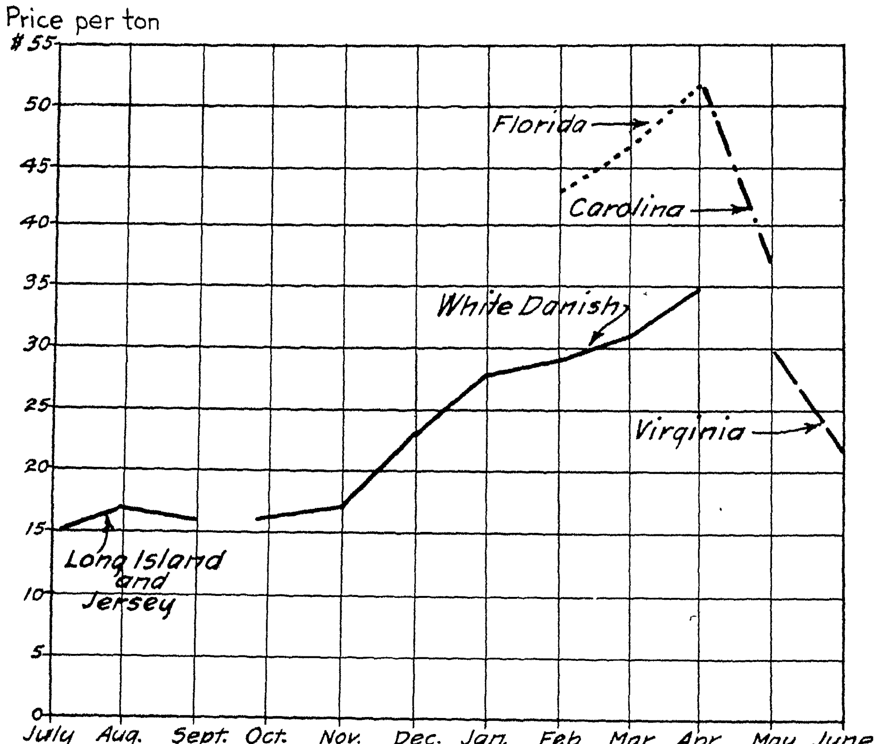


FIGURE 42. AVERAGE WHOLESALE PRICE OF FLORIDA, CAROLINA, VIRGINIA, LONG ISLAND AND NEW JERSEY, AND WHITE DANISH CABBAGE IN NEW YORK CITY, FOR THE TWENTY-TWO YEARS FROM 1900 TO 1921

spinach, and celery, and many other kinds of cheap, fresh, green food, which lessens the demand for cabbage. The price declines until in June it is only slightly higher than the prices from July to November. With this arrival of spinach, celery, lettuce, and other crops, up-state cabbage suffers competition not only with the new southern cabbage, but also with the large supplies of all green vegetables.

Under normal conditions, the various producers might profit by the following suggestions: late-cabbage producers in New York should not as a rule be in any particular hurry about selling; Florida producers would apparently have no particular advantage in trying to get their cabbage on the early market, because the prices are higher in March and April than they are earlier in the season; for South Carolina and Virginia producers, the greatest financial advantage would come by getting the crop matured and on the market as early as possible, because for them the price usually continues to decline; for Long Island and New Jersey producers, there apparently is no advantage in either reaching the market early in the season or reaching it late. It has been shown, however, that in years of unusually large crops, the advantage comes from selling early, and in years of extremely low crops the advantage comes from holding for a late market and advances in price.

SIZE OF CROP, AND PRICE

Most cabbage growers are not particularly interested in the price which the late crop brings after February. It has been previously shown that 68 per cent of the cabbage stored at Little York was out of the storehouse by the first of February, and also that of 27,290 tons of cabbage bought by Mr. Salisbury from farmers over a period of twenty-eight years at Little York, only 13 per cent was purchased after that date. Therefore, the question resolves itself largely into a comparison of harvest-time prices (November) and out-of-storage prices (largely December 15 to February 15, making January a good month to use).

The size of the combined Florida and New York crops, or of the New York crop alone, or of the late cabbage crop in the northern States, has a striking influence on the prices received for cabbage in New York City, and usually New York prices are an indication of prices at other leading markets. A comparison of the November price with the January price for the eight seasons from 1915–16 to 1922–23, inclusive, is given in figure 43. In years of a large New York crop there is very little increase in price from November to January, and in years of a short crop the increase is notable. Since New York grows and ships annually from five to eight times as much Danish cabbage as New York City uses, and since practically no other late cabbage than up-state Danish is used in New York City, the price for that stock must depend largely on the size of the New York crop.

Wisconsin grows most of the remainder of the late cabbage that competes with the New York crop in markets within reach of the latter. Wisconsin's production, however, is only about half of New York's production; but it is usually low or high according as the New York crop is smaller or larger. These facts are shown in figure 12. It therefore follows that prices in Chicago and New York City, and in the smaller cities within 500 miles

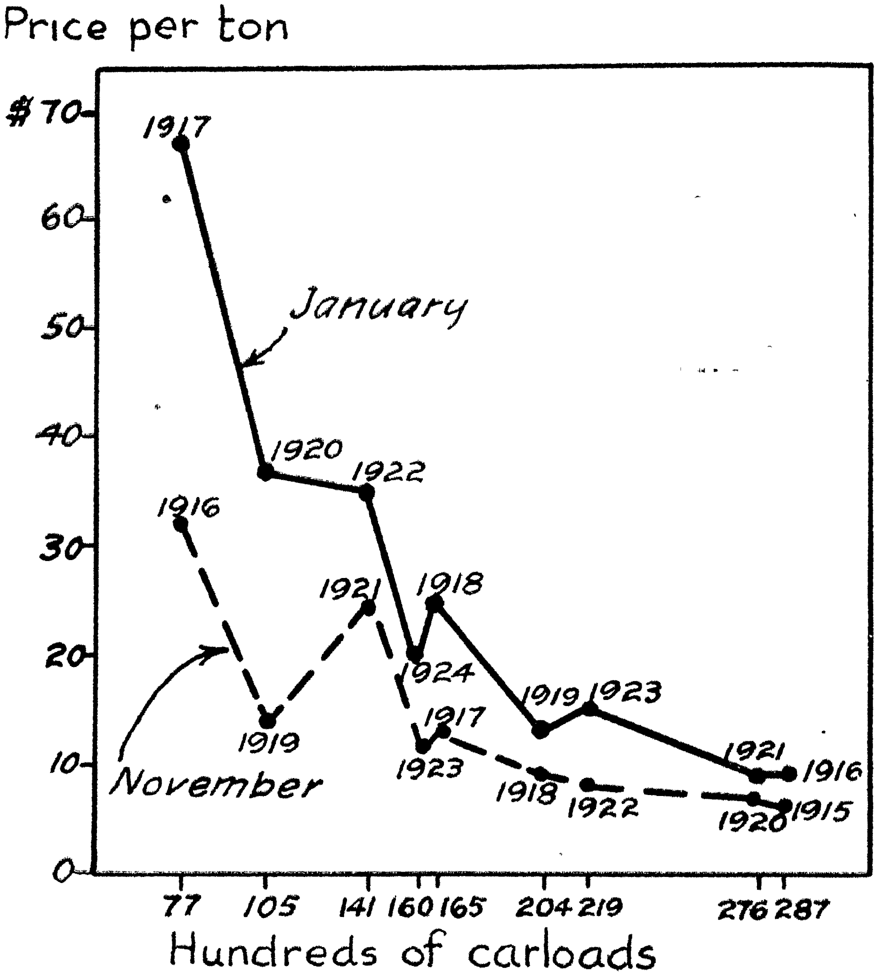


FIGURE 43. RELATION OF THE SIZE OF THE CROP IN NEW YORK STATE TO NOVEMBER AND JANUARY WHOLESALE PRICES OF WHITE DANISH CABBAGE IN NEW YORK CITY, CORRECTED FOR PRICE LEVEL

which are the main outlets for the late cabbage crop of New York and Wisconsin, will be high or low according to the scarcity or the plentifulness of the crop in these two States.

Large crops are accompanied by prices so low that they are less likely to be broken by heavy shipments. When a large amount of cabbage is in storage, the price is more quickly broken.

The demand for the crop rests on the consumers' appetite for cabbage. If too much is eaten in the early part of the season, consumption will be smaller toward spring. This may account for the receipts of late cabbage in New York being less in large crop years than in small crop years. The yearly cabbage crop in various localities is given in table 90:

TABLE 90. SIZE OF CABBAGE CROP IN VARIOUS LOCALITIES IN EACH YEAR SINCE 1915

Year	Hundreds of carloads				
	New York, including Long Island	Florida	South Carolina	Virginia	New York and Florida
1915	....	21	17	35	314
1916	77	27	17	37	86
1917	165	9	7	16	204
1918	204	39	22	18	223
1919	105	19	12	13	156
1920	276	51	12	13	302
1921	141	26	31	30	203
1922	219	62	31	29	232
1923	160	13	32	42	193
1924	245	33	12	43	....

Professor G. P. Scoville, of the Department of Agricultural Economics and Farm Management of this College, studied the relation of the size of the northern crop to the average seasonal wholesale price of cabbage in

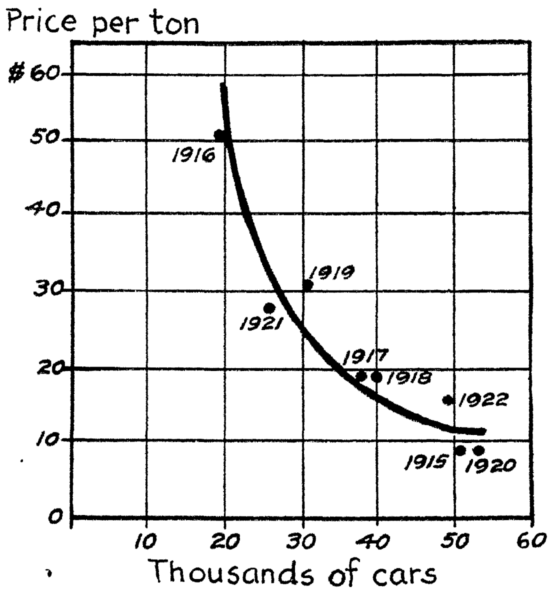


FIGURE 44. RELATION OF THE SIZE OF THE NORTHERN CROP TO THE SEASON'S AVERAGE WHOLESALE PRICE OF CABBAGE IN NEW YORK CITY
(Prepared by G. P. Scoville)

New York City. He has kindly furnished figure 44 for this bulletin. His method of forecasting the price from the size of the crop is

$$\text{Season's price, corrected for price level} = \frac{462}{\text{thousands of cars of cabbage} - 12}$$

This result, when multiplied by the United States Labor Bureau's current index for all commodities, with figures for 1913 as 100, gives the predicted price on the basis of the current price level, as follows:

Size of northern crop (thousands of cars 12.5 tons each)	Expected wholesale price in New York City, 1913 price level
20	$58
25	36
30	26
35	20
40	16
45	14
50	12
55	11

SEED PRODUCTION AND MARKETING

New York State, including Long Island, annually grows from 500 to 700 acres of cabbage seed. Most of this is grown on Long Island and in Suffolk County, and chiefly under contract for two firms, the J. M. Lupton Co. and Linneus Allen, both of Mattituck. Very few up-state growers have attempted to produce cabbage seed on a commercial scale. Some who have succeeded are Reed Bros., of Cortland, J. W. Alvord, of Kirkville, and O. R. Robson, of Hall. Much of the seed used is imported.

The following comments on the marketing of cabbage seed, made by a leading and successful up-state producer in a letter to the author, give the point of view of a farmer who has had several years of experience in producing cabbage seed:

"Hardly know just how to answer you about your seed-marketing question. We have had fifteen years of it, and find it, just like anything else, to be full of pitfalls and very subject to public opinion. The variation of seasons and the different conditions under which the various growers use seed has a great bearing upon a man's success. One must have something exceptional to stick at the game at all, as the American public outside of a person's acquaintances are very apt to want to try something else. Jones had a good crop from common seed because he had it on the river bottom and put manure enough on it to grow two crops. His other neighbors forgot or never knew anything about his conditions. His crop is all that is talked about. All the neighbors want to try the kind of seed Jones used, the next year.

Extensive advertising will sell almost anything but the repeat orders are what tell the satisfied story. Honesty and a square deal, with the willingness to stand behind any mistakes, are only necessary foundation stones for a continuous business. Personal willingness to help where a man has trouble, and all the first-class up-to-date information about a crop, all help towards success. A man who wrote last night wanted one-quarter pound of seed to set five acres of cabbage. This needs personal explanation, and a friend and customer will be the result. Competition is constantly getting stronger.

The best type of cabbage head, from the standpoint of yield, is what might be called a *flattened-ball head*. From the standpoint of keeping in storage, the round, true Danish Ball Head is better. The flattened-ball type has been developed by some seedsmen by selecting heads of ideal type in this respect, carrying the heads over, and growing the seed from them the next summer. This procedure is in direct contrast to the production of seed from late-season-set plants that have never headed.

SEED CONTRACT

CROP OF 19. . .

THIS CONTRACT made and entered into between..............................of..........................N.Y., hereinafter to be known as the purchaser, and...of ....hereinafter to be known as the grower, is hereby mutually agreed to for the purpose of growing and purchasing the seeds below named on the terms and conditions specified as follows:

1. Plants shall be grown on good soil and cared for in accordance with the best available methods.

2. Plants shall be transplanted into the field before the................day of............ ...19....

3. In the case of seeds sown in the field the plants shall be thinned to a distance of............inches in the row before the same date as set for transplanting, and carefully hoed and cultivated.

4. It is mutually agreed that in the event of the grower not complying with any of the above clauses the price to be paid by the purchaser shall be automatically reduced ten cents per pound from the price fixed by this contract, and subject to the same conditions.

5. The purchaser shall be under no obligation to accept seed—

(a) from plants too small to be properly rogued in the judgment of the purchaser.

(b) from plants planted, wintered or grown, in any manner other than a manner approved by the purchaser.

(c) from plants grown within fifty rods of another variety of Cabbage or within seventy-five rods of Brussels Sprouts, Kale or similar plant.

(d) the vitality of which has been impaired, or which will not show a germination of 90 per cent at time of delivery to the purchaser.

6. The Seed Stock shall be furnished free of all charge by the purchaser.

7. None of the Seed Stock, plants or crop of seed produced therefrom, shall be sold, given or delivered to any other than the purchaser without express or special permission of the purchaser, and all the product of the seed stock shall be delivered to the purchaser at time of recleaning the crop and that all seeds so delivered shall be the product of the seed stock and no other.

8. The crop shall have all chaff removed by the grower before delivery at the warehouse of the purchaser. to be finally recleaned and weighed by both parties at such time as may be agreed upon.

9. Payment shall be made as follows:—Amount to be subject to a discount of five per cent within 30 days from delivery of the crop or net before April 1 following at the option of the purchaser.

No. of acres	Variety of cabbage	Price per lb.
....	....	....
....	....	....
....	....	....

....

....Grower. Per..

FIGURE 45. FORM USED IN CONTRACTING FOR CABBAGE SEED

The advantage is that it allows a selection of the most perfect heads for the production of seed. Reed Bros., of Cortland, have had distinguished success in developing a high-yielding strain of cabbage by this method. The chief points that they have had in mind in the selection of heads are: compactness; solidity; flattened-ball shape, tapering at the base to facilitate harvesting; leaves that overlap past the center of the head; and an attractive pink color.

Besides the relation of rainfall to yield, which is discussed elsewhere in the bulletin (page 31), the kind of seed used is important. Much seed found on the market is grown from immature plants. This does not produce the compact, closely-grown heads, with long leaves overlapping past the center, which make the cabbage heavy. Whenever possible, good seed grown from stock that has been selected for a number of years for these characteristics should be used. The cost per ton will be kept down by the use of such seed.

SUMMARY

The marketing of cabbage deserves consideration from each group of agents concerned in the business. The following suggestions are offered:

FOR THE PRODUCER

1. Use only seed from selected, improved, high-yielding strains. This is the first insurance of a good yield. Much seed grown from immature plants is sold. Such seed does not produce firm, heavy heads.

2. Grow disease-free, solid, well-shaped, and well-colored heads of medium size. Trim well, and keep the soft heads for use at home. This practice results in uniform cabbage of high quality, and is the best means of obtaining a good price.

3. Study the governmental forecasts of acreage and the reports on conditions for September 1 and October 1. Study the rainfall over the New York cabbage district. This information will enable the grower to form a more accurate opinion of the probable price advantages in holding or in selling at harvest time.

4. In a short-crop year, consider well the holding of part of the crop, unless the fall price is very high. In a large-crop year, if the fall price is extremely low and if the price does not advance, holding may prove profitable if livestock are available to which the cabbage may be fed.

FOR THE LOADER

1. Encourage some of the growers to begin shipments early so that the distribution of the crop may be equalized, the work of the loader made easier, and the time of the farmer saved.

2. Protect the car well with straw and with false floors in severe weather. Frosted cabbage creates expense in the city terminals, and is less desirable than cabbage arriving in good condition.

3. If the cabbage is shipped in bulk, carefully stack it in the car, particularly the top layers, and secure it by well-constructed bulkheads. If the cabbage is sacked, use new sacks with appropriate stamping.

FOR THE STOREHOUSE OPERATOR

1. In filling the house, do not delay until the weather is cold, rainy, or snowy. The cabbage does not go into the house in such good condition, and a congestion of loads wastes the time of the farmer. Sometimes disorderly harvesting results from the hesitation of dealers to buy for storage.

2. Use only medium-sized, disease-free heads for storage. Careful selection at this time prevents waste in marketing, as heads too large or of too poor quality for storage will be readily accepted in fall shipments.

3. Pay attention to regulating the temperature of the house, being careful to admit plenty of air in warm weather to encourage a uniform temperature thruout the house. Heavy shrinkage results in poorly ventilated houses.

4. Encourage the shipping of cabbage when prices begin to rise. Hesitation in shipping in anticipation of sharply rising prices results in glutted markets, ruinous prices, rejected cabbage, and an uneven movement to market. A steady movement to market would result in less violent fluctuations in cabbage prices.

FOR THE WHOLESALE RECEIVER

1. Encourage shipments early enough when the market is rising, to help stabilize prices.

2. Package the product attractively.

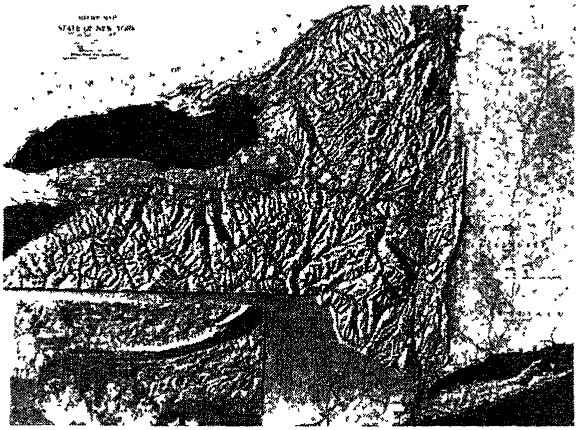
3. Try to get reasonably fair prices; that is, do not depend entirely upon the volume of business for profits, as this encourages a perpetually dull market.

Bulletin 444

October, 1925

The Climate of New York State

R. A. Mordoff



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CONTENTS

THE CLIMATE OF NEW YORK STATE [1]

R. A. MORDOFF

The agriculture of a State is undoubtedly influenced more by its climate than by any other factor. In some sections, temperature and the length of the growing season determine the limits of growth of certain crops; in other sections, rainfall is the dominating influence; and in still others, sunshine is most important.

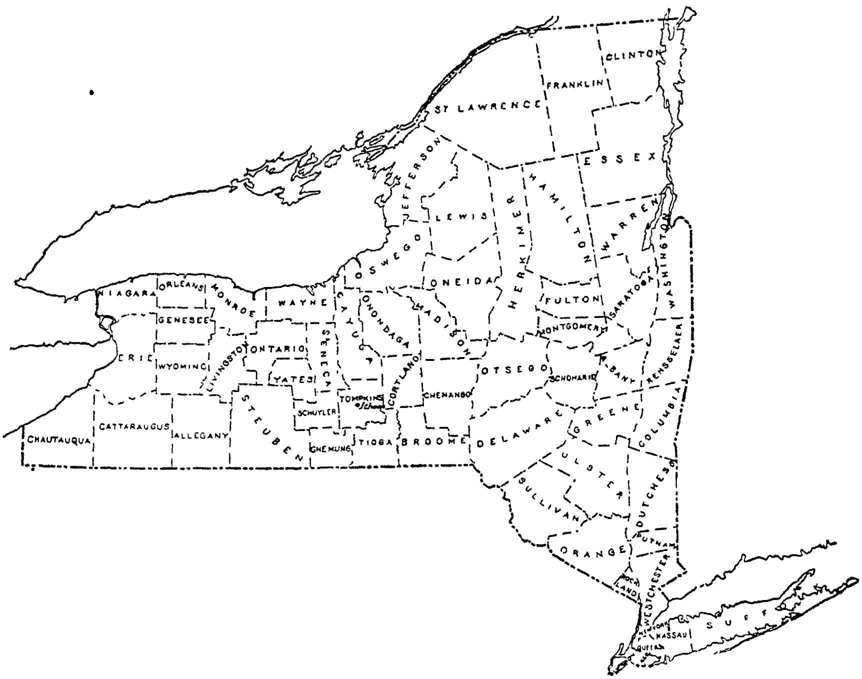


FIGURE I. KEY MAP SHOWING LOCATION OF COUNTIES IN NEW YORK

Owing to its location in the belt of the prevailing westerly winds and to the diversity of its physical features, the several parts of New York State experience a variety of climates. As a result, practically all crops common to the temperate zone may be successfully grown within its boundaries.

Due to this diversity of climate in the State, it is not surprising that there is great popular interest in the weather, and hence that the first organization for local climatic observation in America was the one inaugurated in 1825 by the New York Board of Regents. This was continued

[1] Also presented to the Faculty of the Graduate School of Cornell University, August, 1921, as a part of a major thesis in partial fulfillment of the requirements for the degree of doctor of philosophy.

at several stations until 1863, when, with other scientific enterprises, it was abandoned because of the Civil War. However, the observations were continued at military posts, as well as by some private individuals, and reports were made direct to the Smithsonian Institution at Washington, D. C. In 1870 the National Weather Service was organized by an act of Congress, and five regular weather-observing stations were established in New York. Under the later administration of the United States Weather Bureau, the number was increased to nine regular stations. A key map of the counties of the State is here presented as figure 1, and the location of these observing stations is shown in figure 2.

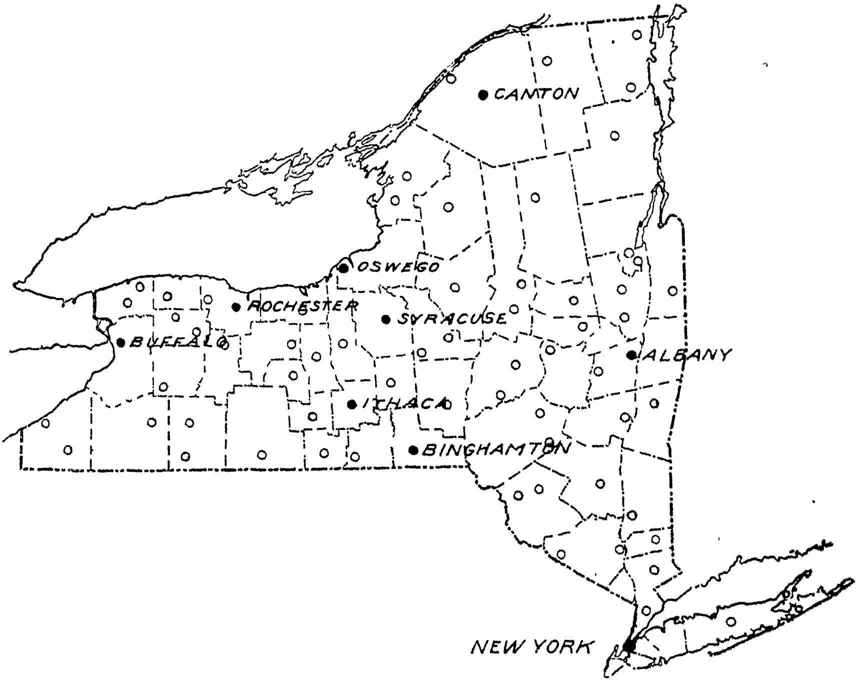


FIGURE 2. UNITED STATES WEATHER BUREAU STATIONS IN NEW YORK

GENERAL CLIMATIC CONTROLS

In order to understand the climate of the State, it will be necessary to consider some of the fundamental controls of climate in general.

The principal factors that determine the general climate of a region in the intermediate zones of the earth are: (1) latitude, or the distance north or south of the equator; (2) altitude, or the elevation of the land surface above sea level; (3) distance and direction from large bodies of water; and (4) location of the place with respect to the normal path of storms.

The latitude determines the amount of heat energy, or insolation, received from the sun. Other things being equal, the distance north or

south of the equator would determine the temperature of a locality, because the sun's rays strike the earth at a greater angle with increasing latitude. In general, the average annual temperature decreases about one Fahrenheit degree for each degree of latitude traveled, either north or south of the equator.

The effect of altitude is to cause an average decrease in temperature of about one Fahrenheit degree for each 300 feet of ascent. For such a State as New York, with the elevation of its land surface ranging from sea level to more than 5000 feet (figure 3), this becomes an important

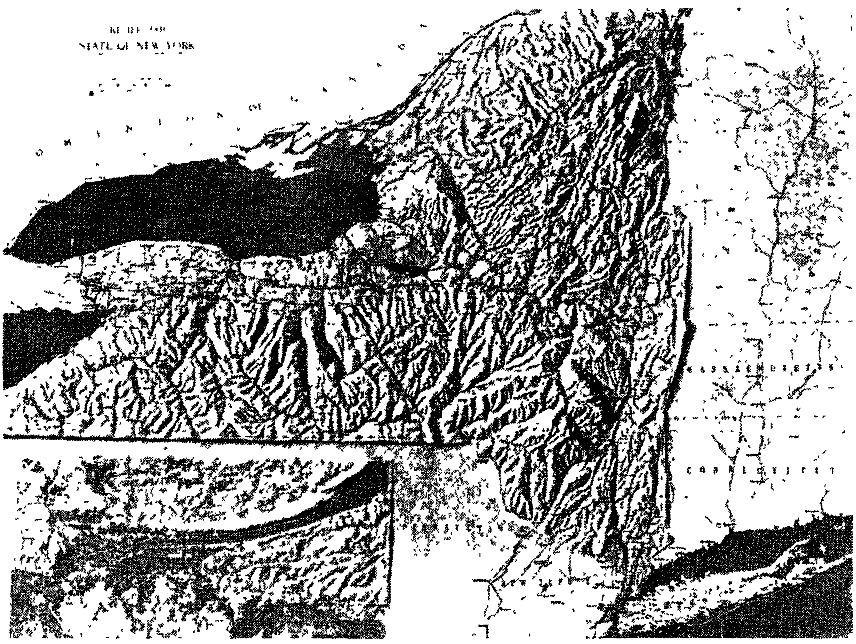


FIGURE 3. RELIEF MAP OF NEW YORK

influence in the local climate of many sections, as is clearly indicated by the wide difference between the temperature condition of the plateau divisions and that of the adjacent lowlands. Also, the elevated sections usually receive a heavier rainfall than do the lower areas. The air currents are forced to rise with the slope, and, as they rise, they cool because of the greater altitude and expand because of the decreased pressure; and, since the expansion itself involves a fall in temperature, the effect is to produce greater condensation and precipitation. This is especially true of slopes facing the prevailing winds.

It is a well-known fact that land heats and cools faster than does water. Therefore, temperatures over water areas are more equable than those over land areas, and, generally speaking, regions near large bodies of water are not subject to the sudden changes in temperature that are

experienced by localities farther inland. The location of the water mass with respect to the prevailing wind is even more important than is the distance. This is very well shown by a comparison of the temperatures of New York City with those of Eureka, California. Although the latitude and the mean annual temperature are practically the same for the two places, New York has an average annual range of temperature, between the warmest and coldest months, of about forty-three Fahrenheit degrees, while the average annual range at Eureka is only nine Fahrenheit degrees. The explanation of this wide difference is found in the influence of the prevailing winds. The temperature of Eureka is dominated by the prevailing westerly winds blowing from the Pacific Ocean. These winds are relatively warm in winter and cool in summer, due to the slow heating and cooling qualities of the water. On the other side of the continent, New York City is situated in the same prevailing westerly winds, but here they blow from the interior of the continent and are decidedly cold in winter and warm in summer.

The tempering effect of the Great Lakes is similar, except in degree, to that of the Pacific Ocean, and is plainly evident in the more equable climate of those parts of New York State bordering on Lake Ontario and on Lake Erie. The central lakes of New York exhibit the same moderating influence, but to a still lesser degree.

Cyclonic storms follow several fairly well-defined routes or tracks across the continent. Many of these storms have their origin in the western part of the United States and Canada, and are carried somewhat southeastward over the western half of the country, changing their course to northeastward when they reach a point a few hundred miles east of the Rocky Mountains. The farther southward a storm travels, the more pronounced is the turn to the northward in the Middle-Western States. Other storms originate in the Southwestern States, in the Gulf of Mexico, or in adjacent waters, and move northeastward. As a result, the majority of these storms either cross New York or pass so near it that their influence is felt over at least a part of the State.

The small destructive whirlwinds which are often incorrectly called cyclones are not cyclonic storms. Cyclonic storms are vast atmospheric disturbances covering perhaps as much as one-half of the United States at one time. Since these storms are in the path of the prevailing westerly winds, they move in a general west-to-east direction; and at the same time they have a rotary motion, counterclockwise in the northern hemisphere.

The winds blow from all sides spirally inward toward the center of the storm, ascending as they advance toward the center. Thus, to the east of the storm center the winds blow from an easterly or a southeasterly quarter, and to the west of the center from a westerly or a northwesterly quarter. Therefore, preceding these cyclonic areas of low pressure, the temperature normally rises, due to the indraft of warm air from the south or from over the ocean. After the storm center has passed and the wind has changed, the temperature falls rather rapidly because of the winds that come from the cooler areas to the north. Normally, a cyclone is accompanied by precipitation. The warm, moist air rising at the center of the low-pressure area is cooled by expansion, thus causing the condensation of the moisture contained in the air as vapor.

In the northern belt of the prevailing westerly winds, in which New York State is situated, anticyclones, or areas of high pressure, usually follow the cyclones and bring with them weather conditions just opposite to those that accompany the cyclones. The anticyclones move in the same general eastward direction as do the cyclones. This alternation of cyclones and anticyclones, with the accompanying wind changes, gives New York State its variable temperatures and a rainfall which is fairly well distributed throughout the year. Thus periods of extreme weather conditions of any kind are infrequent and of short duration over the entire area of the State.

These are the larger and more general climatic controls. The local aspects of the climate of New York are shown in detail by the climatological tables and charts presented in this bulletin.

THE CLIMATE OF THE STATE

New York State has a diversity of climate not usually encountered within an equally restricted area. In some respects nearly every locality has a climate of its own. This is due primarily to the varied topography of the State, and to its position between the Great Lakes and the Atlantic Ocean. Because of this diversity, and for convenience in discussion, the State has been divided into ten climatic divisions, or regions, as shown in figure 4. The lines that separate these divisions are, of course, arbitrary,

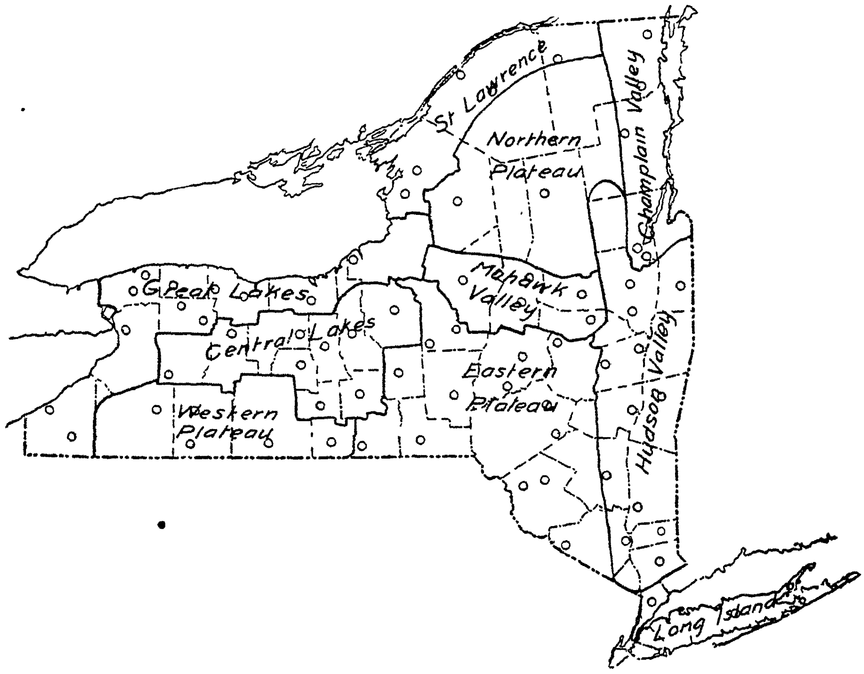


FIGURE 4. CLIMATIC DIVISIONS OF NEW YORK

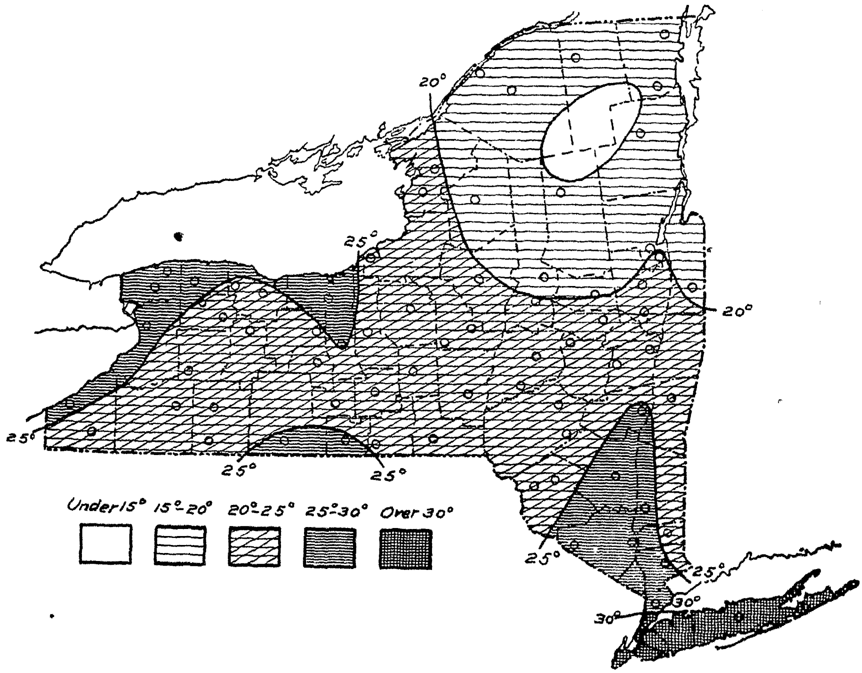


FIGURE 5. MEAN JANUARY TEMPERATURE

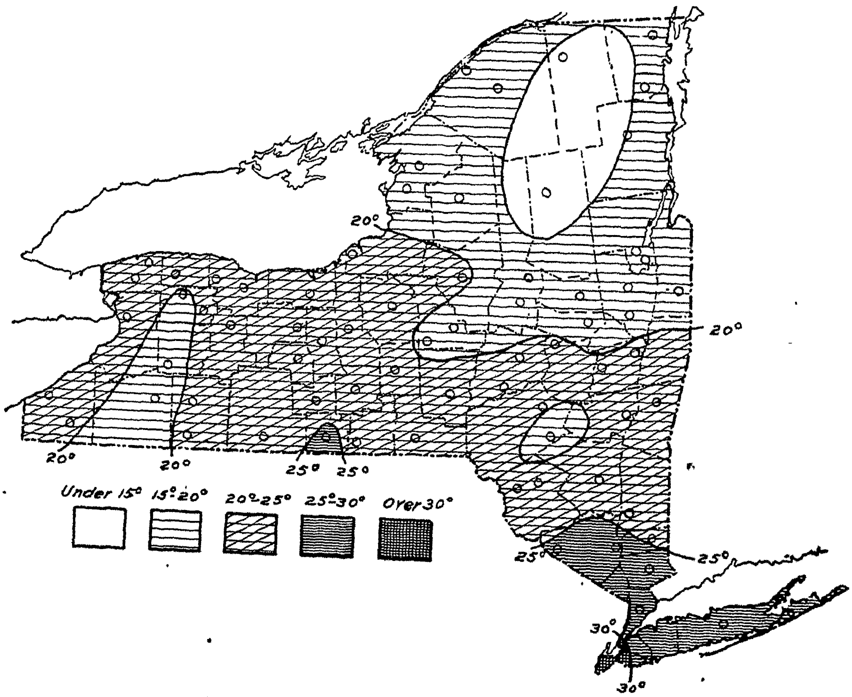


FIGURE 6. MEAN FEBRUARY TEMPERATURE

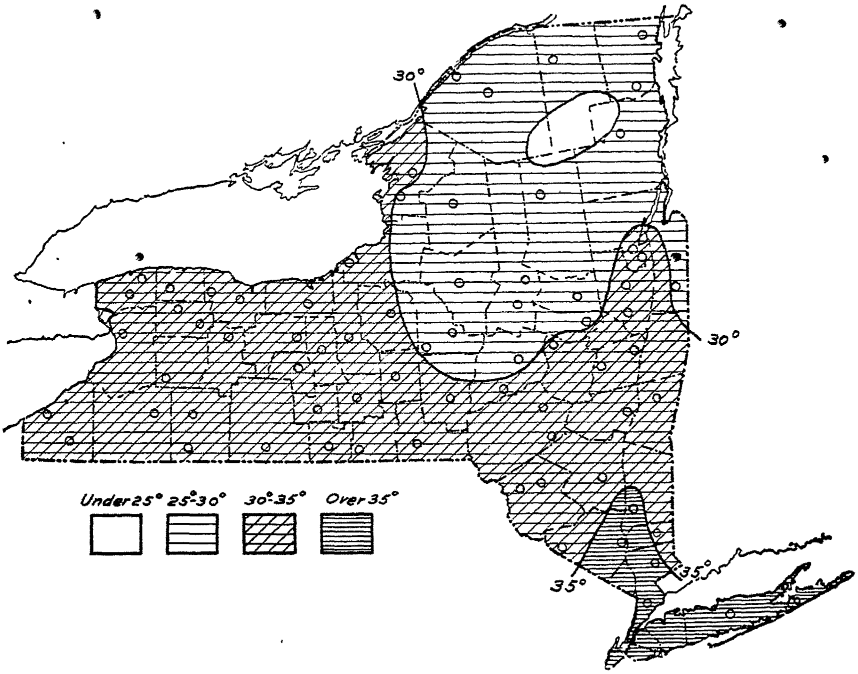


FIGURE 7. MEAN MARCH TEMPERATURE

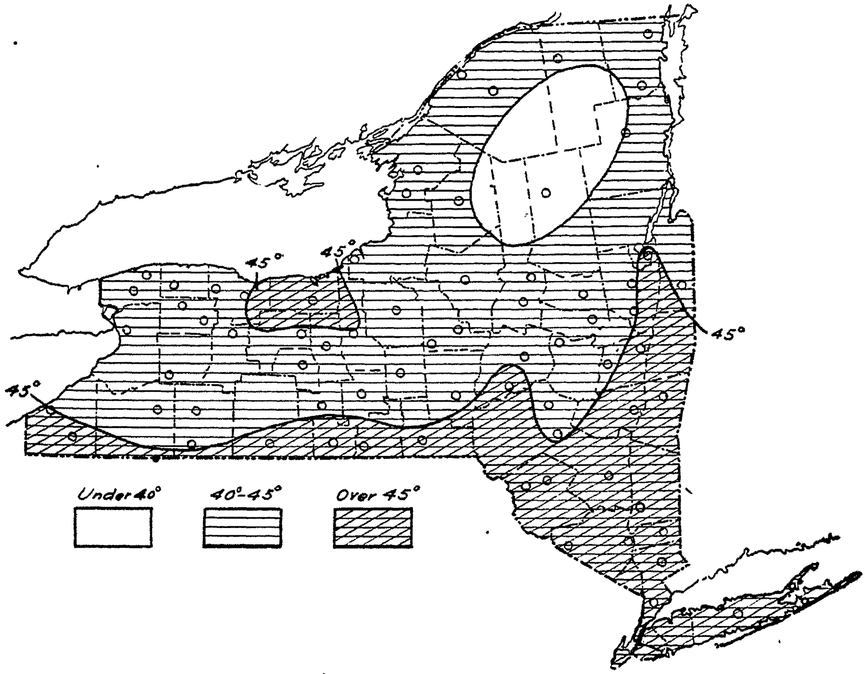


FIGURE 8. MEAN APRIL TEMPERATURE

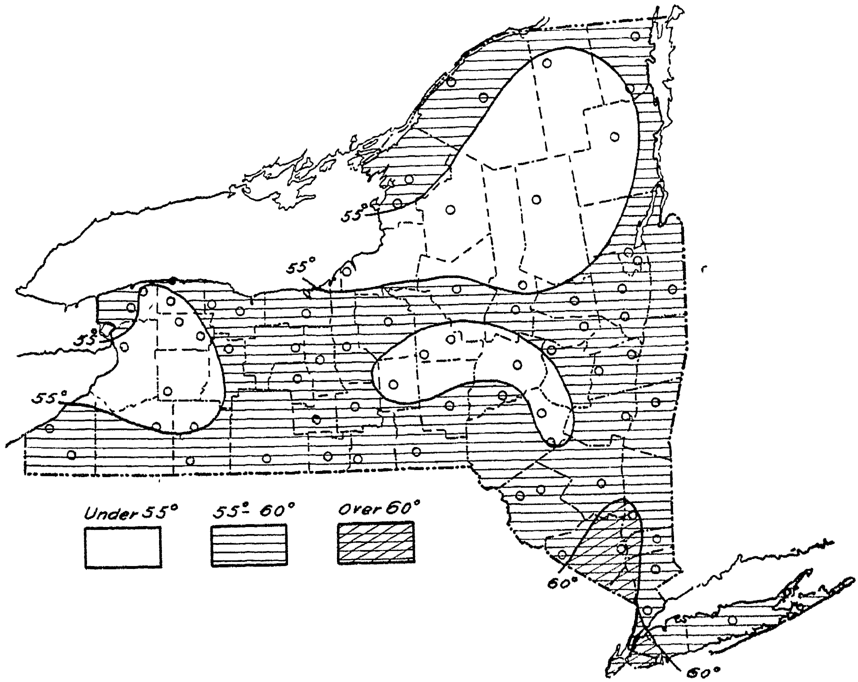


FIGURE 9. MEAN MAY TEMPERATURE

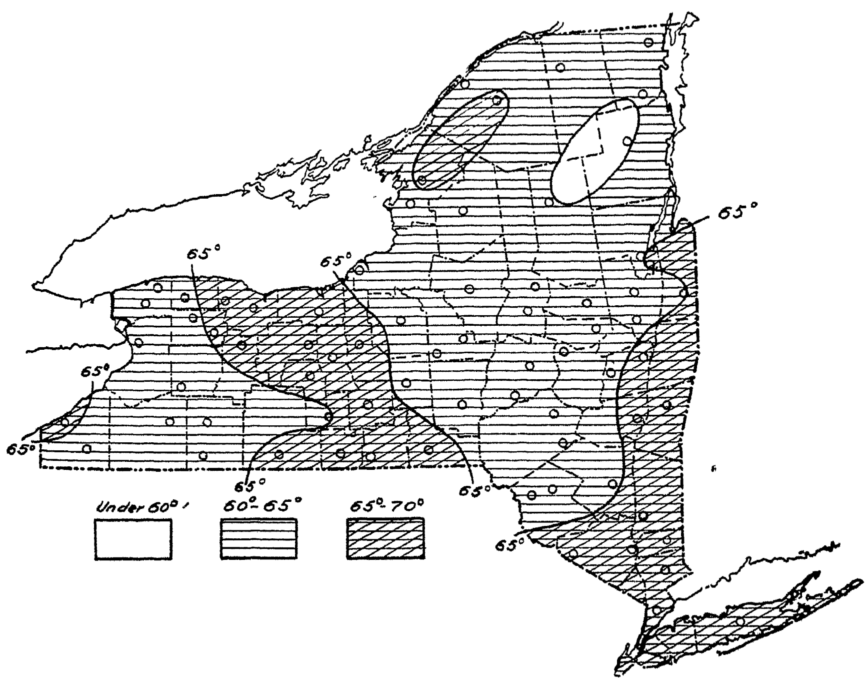


FIGURE 10. MEAN JUNE TEMPERATURE

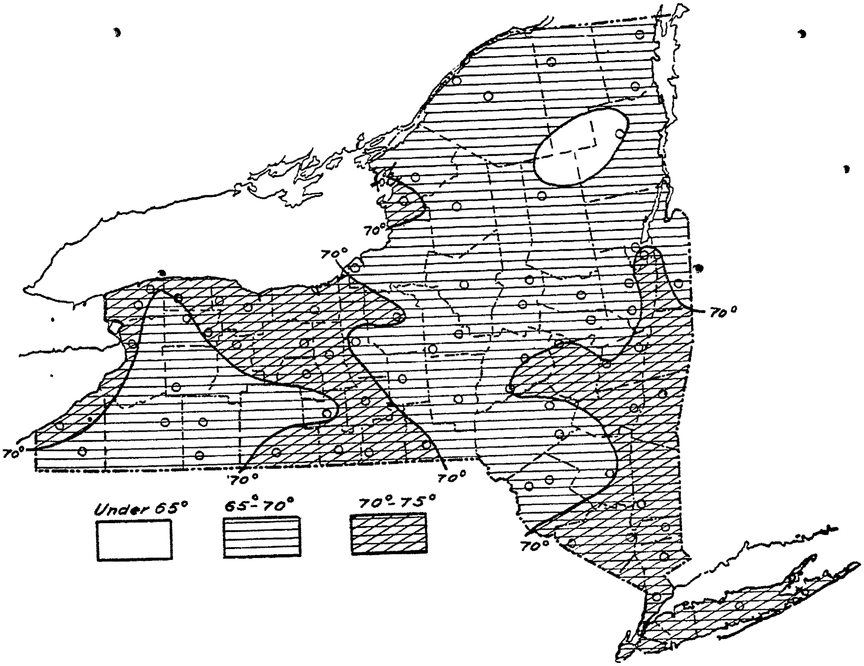


FIGURE 11. MEAN JULY TEMPERATURE

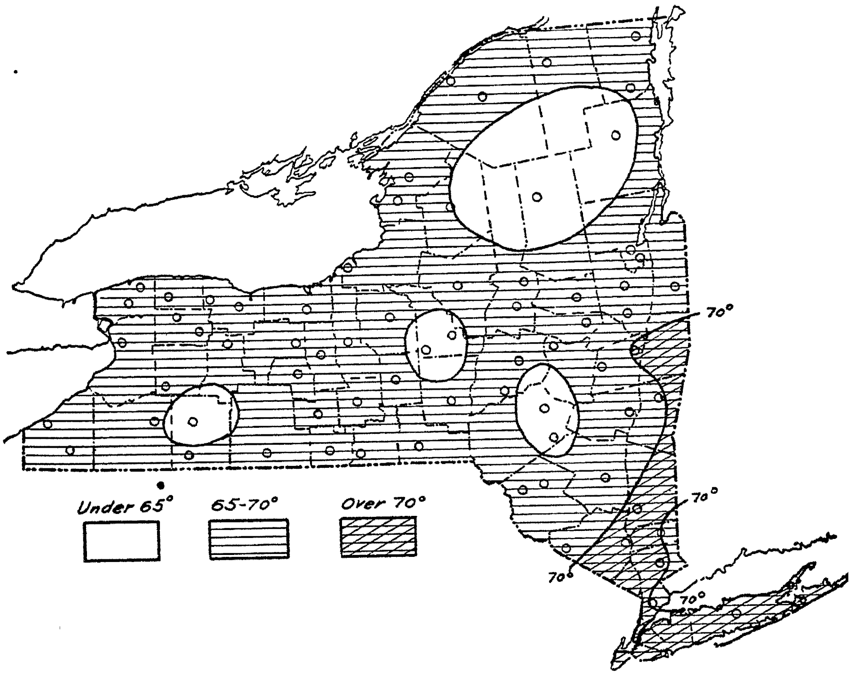


FIGURE 12. MEAN AUGUST TEMPERATURE

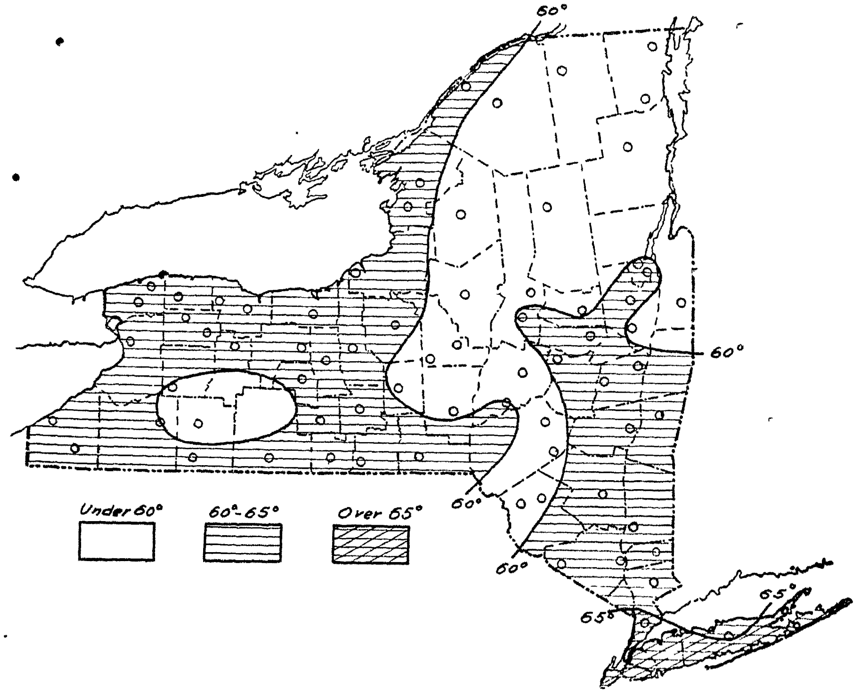


FIGURE 13. MEAN SEPTEMBER TEMPERATURE

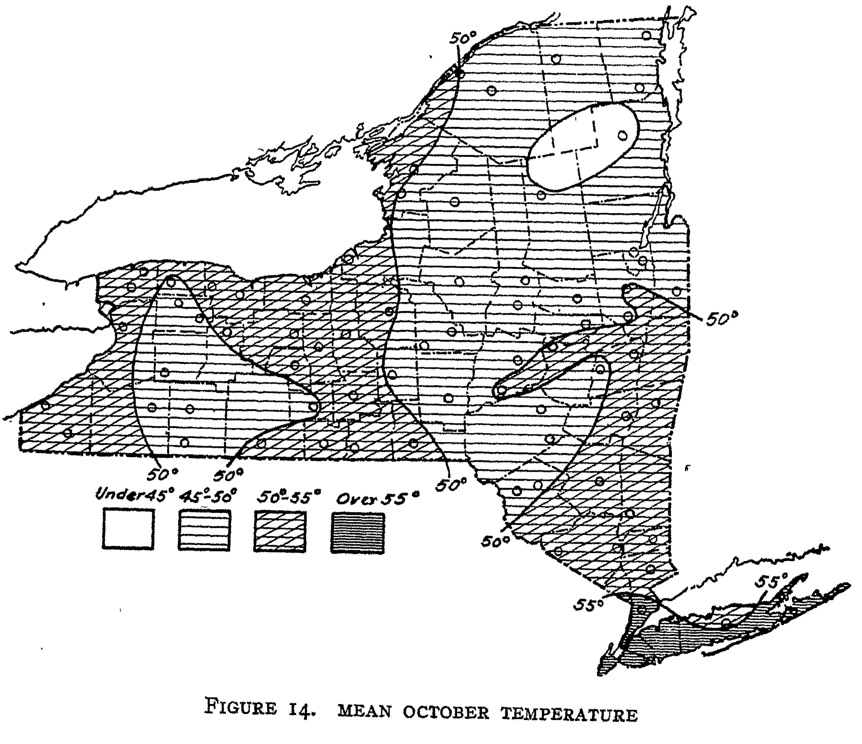


FIGURE 14. MEAN OCTOBER TEMPERATURE

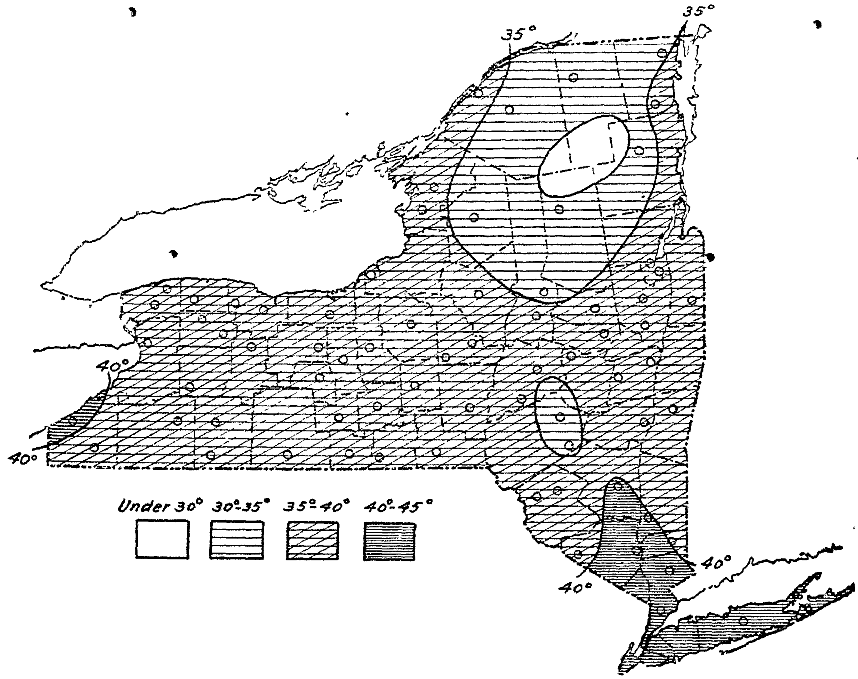


FIGURE 15. MEAN NOVEMBER TEMPERATURE

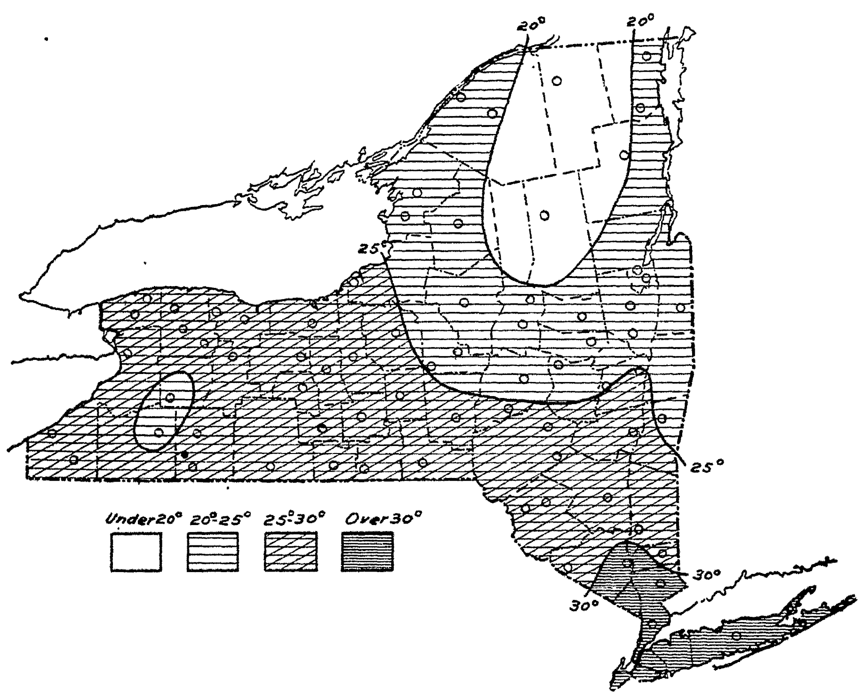


FIGURE 16. MEAN DECEMBER TEMPERATURE

and the changes of climate from one division to another are gradual. Nevertheless each division possesses certain general climatic features not common to the other divisions.

TEMPERATURE

The general distribution of temperature for the State, and the changes that take place from month to month, may best be indicated by charts showing the average temperature for each month. These charts, which are shown as figures 5 to 16, were made from the average monthly temperature records as reported by local observers to the Weather Bureau. In compiling and correlating the data relating to the various weather elements, consideration was given to the length, the continuity, and the apparent accuracy, of the individual record, as well as to the geographic location of the station.

The temperature of the Great Lakes division is largely influenced by the proximity of Lake Ontario, which borders it on the north, and of Lake Erie, which forms a part of the boundary line on the west. Lake Erie, lying directly in the path of the prevailing westerly winds, produces an important effect, especially over the land that slopes toward the west. The Chautauqua County grape belt, which extends along the southern shore of Lake Erie for a distance of about sixty miles and is from two to six miles wide, has the most equable climate in the State, except the region along the Atlantic Coast. This is directly due to the tempering influence of the lake, which holds vegetation in check in the spring until the danger from frost is over, gives long, mild autumns with unusually late fall frosts, and results in winters that are much less severe than are experienced in the more elevated sections a few miles to the east.

The effect of Lake Ontario in modifying the conditions along its southern border, while not so marked as that of Lake Erie, is important. When cold waves attended by low temperatures sweep down from the Canadian Provinces, the difference in temperature between the areas on the northern and those on the southern sides of the lake frequently amounts to twenty or more Fahrenheit degrees. Probably the most noticeable influence of Lake Ontario is over that part of the St. Lawrence division which lies between the lake and the Adirondack Mountains. Here the prevailing westerly winds that traverse the entire length of Lake Ontario produce their maximum effect, tempering the heat of summer and the cold of winter, except when the lake is frozen over. As a result, the springs are backward and cold but the autumns are comparatively warm. The winter season is severe, due to the frequency of storms and cold waves.

The plateau divisions present an almost typical continental type of climate. The elevation and the comparatively dry atmosphere combine to give high day temperatures, but the nights are decidedly cool owing to the rapid loss of heat by radiation. During the summer months the maximum temperature often reaches 90° F. or above. Winter begins early and continues severe throughout the season; temperatures of −40° F. are not uncommon in the more exposed localities.

Long Island and the Atlantic Coast exhibit conditions that are in marked contrast to those of the plateau divisions. The climate of the Long Island division is influenced more by the ocean than by the adjacent

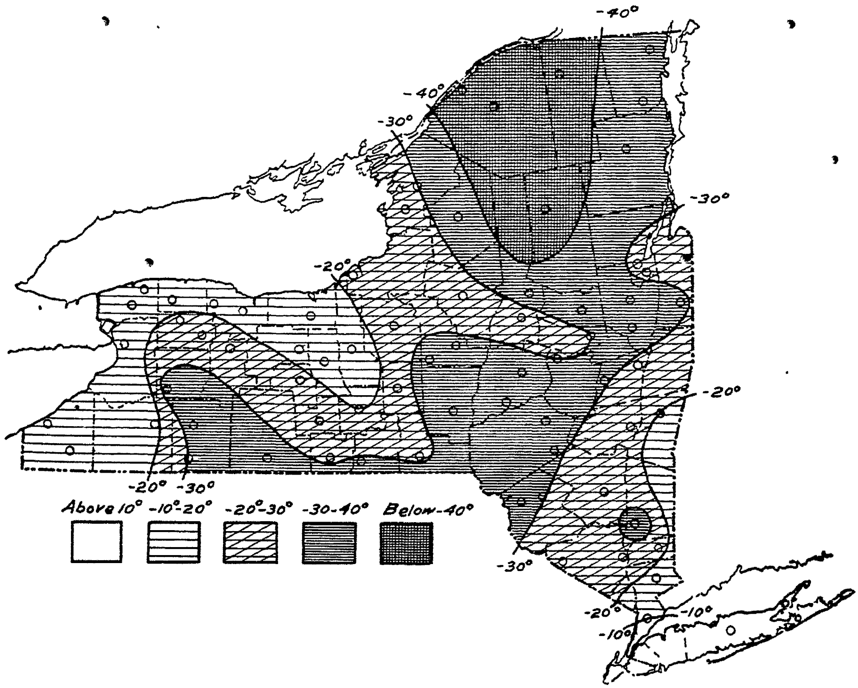


FIGURE 17. LOWEST TEMPERATURES RECORDED

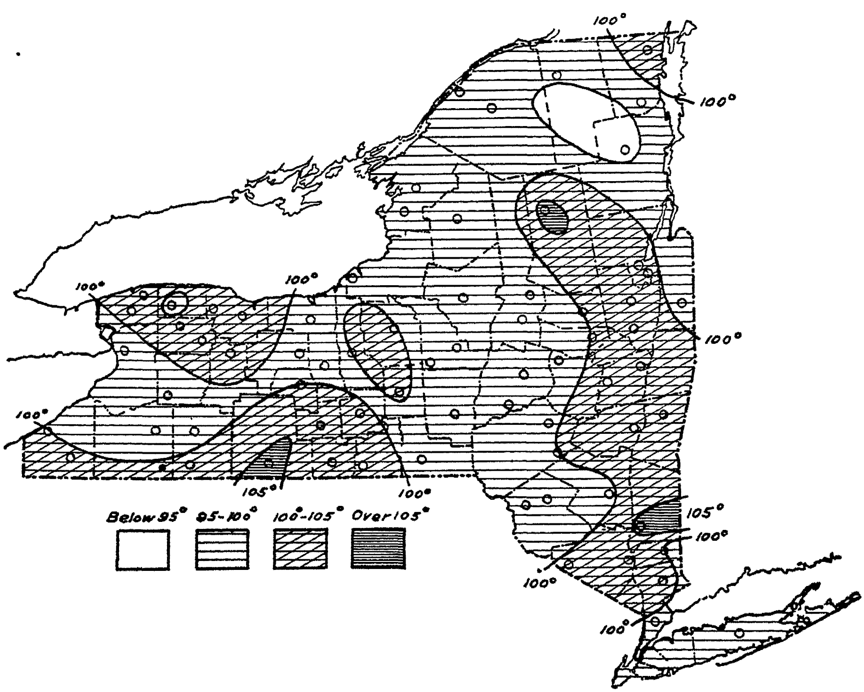


FIGURE 18. HIGHEST TEMPERATURES RECORDED

land surfaces, and is characterized by mild winters and relatively cool summers with comparative freedom from sudden and extreme changes of temperature.

Monthly and seasonal temperature ranges

During the month of January, which may be used to show the typical winter conditions, there is a greater range of temperature than at any other time of the year. The highest average temperature for the month, as indicated on the January temperature chart (figure 5), is a little above 30° F. in the Long Island division. The lowest average temperature for the same period is slightly below 15° F., and is found in the Adirondack Mountains. The low temperatures here are caused chiefly by the higher elevations and the distance from the ocean. The Western Plateau and Eastern Plateau divisions have about the same January temperature, varying from 20° to 25° F. The Great Lakes, Central Lakes, and Hudson Valley divisions have January temperatures about five degrees higher.

In July the lower temperatures are found in the higher altitudes of the mountainous divisions. The Northern Plateau and Eastern Plateau divisions have average July temperatures of approximately 66° F., while those of the Western Plateau division are about two degrees higher. The highest temperatures for the month are found in the lower Hudson Valley division and the Long Island division. These higher temperatures are due to the location of the divisions at lower altitudes and lower latitudes, and to the warm southwest winds which prevail during the summer.

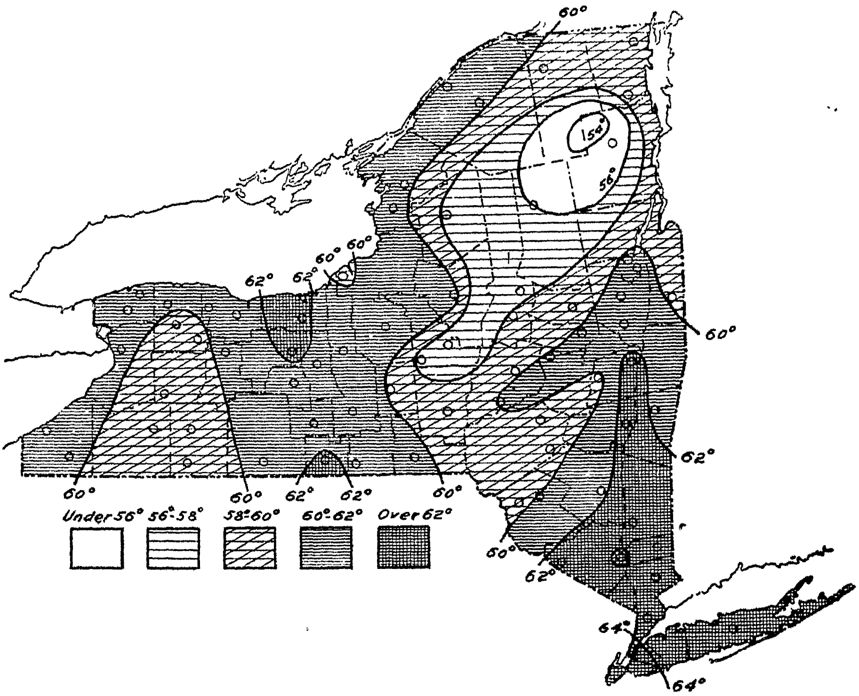


FIGURE 19. MEAN TEMPERATURES FOR GROWING SEASON

The charts of the mean temperatures for April and for October (figures 8 and 14) are somewhat similar, with the exception that the October temperatures are about five to ten degrees higher than those for April. Both of these months may be considered transition periods. The April chart shows the change taking place from winter to summer conditions, and the October chart shows the change from summer to winter conditions. The lowest temperatures recorded in the various parts of the State are shown in figure 17, and the highest in figure 18. It will be noted that very low temperatures have been experienced, −40° F. or lower, generally over the Northern Plateau, and that temperatures of −35° F. are not uncommon over the elevated parts of the Eastern Plateau and Western Plateau divisions.

The relative freedom from excessive cold along the Great Lakes, as well as a longer growing season, are undoubtedly the chief explanations for the successful fruit-growing in that section. Only Long Island and a small part of the adjacent coast enjoy greater freedom from excessive cold in winter than does this area bordering on these lakes.

The temperature during the growing months has a direct bearing on the kind of crops raised, as well as on the yields obtained. The average temperatures for the five growing months, April to August, inclusive, are shown in figure 19.

Frosts

The term *frost* is used to designate a deposit of ice crystals on the surface of plants or other objects, and also to designate temperatures that are injurious to vegetation. Weather Bureau observers use the term in the latter sense, and record three degrees of frost — light, heavy, and killing. Light frost is recorded when only the tenderest plants are injured; heavy, when the injury is more marked; and killing, when the staple crops of the region are killed or badly injured.

If, for any reason, the observer failed to note the dates of frosts, the date of the last freezing temperature, 32° F., in the spring, and the date of the first freezing temperature in the fall, are regarded as the dates of the last and the first killing frosts for the respective seasons. The accompanying charts, figures 20 to 22, show graphically the average date of the last killing frost in the spring, that of the first killing frost in the fall, and the average number of days between frosts. These dates are based on records made at about one hundred and fifty stations throughout the State. The charts, for the most part, are self-explanatory. It may be pointed out, however, that the average dates of frosts, as well as the average number of days between frosts, are simply arithmetical averages. For example, in the region along the east shore of Lake Erie, the average date of the last killing frost in spring falls on May 1, which means that in half of the years killing frost occurred before May 1 and in half of the years it occurred after May 1. It is obvious, therefore, that at the time of the average date as shown by the chart, the risk of frost is 50 per cent, which is entirely too great for tender crops. In the spring, the risk of frost decreases rapidly after the average date, falling to perhaps 30 per cent at the end of five days and practically disappearing at the end of fifteen days. In the fall, the frost risk increases rapidly as the average date of the first fall frost approaches, and is again 50 per cent at the time of the average date.

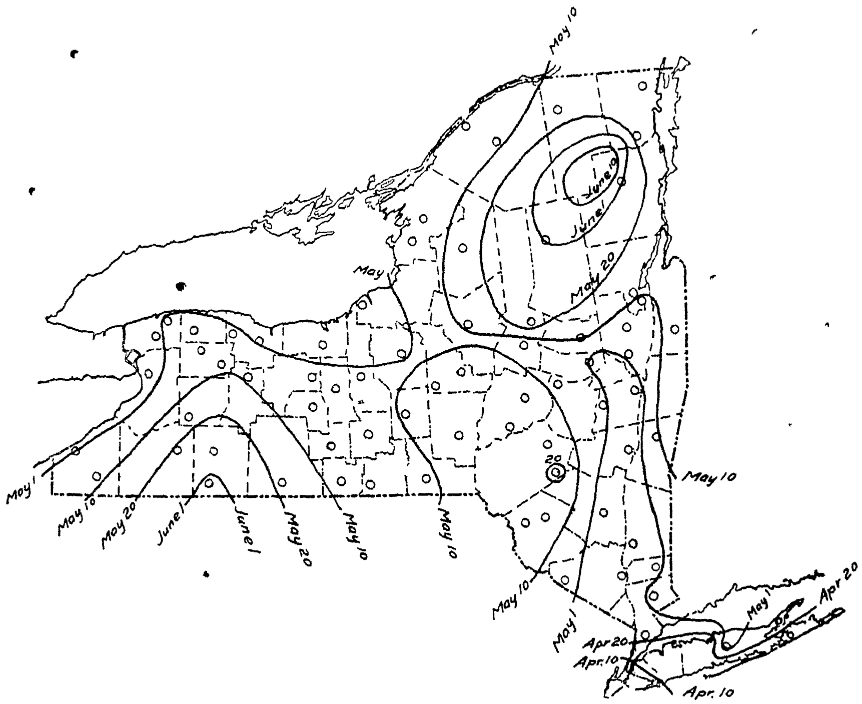


FIGURE 20. AVERAGE DATE OF LAST KILLING FROST IN THE SPRING

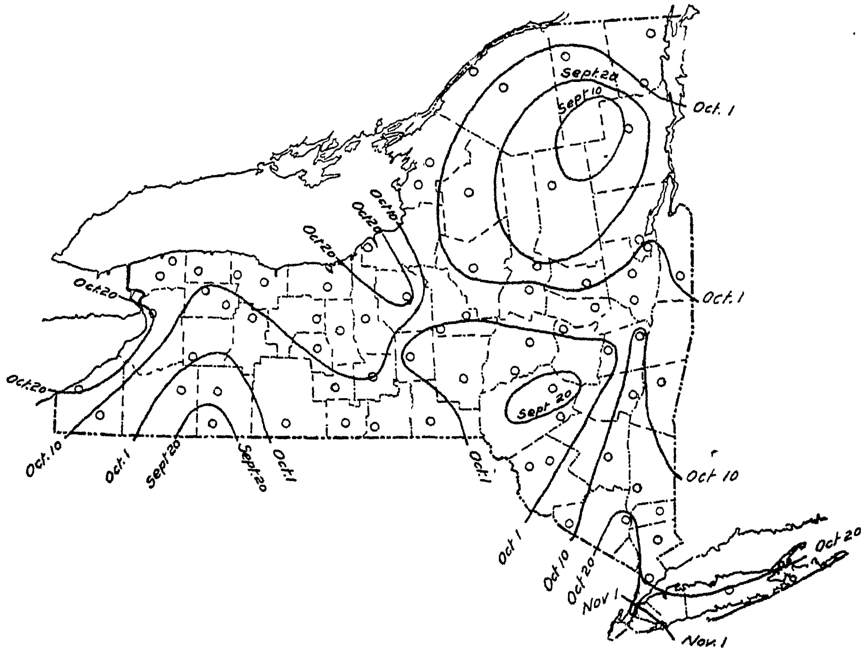


FIGURE 21. AVERAGE DATE OF FIRST KILLING FROST IN THE FALL

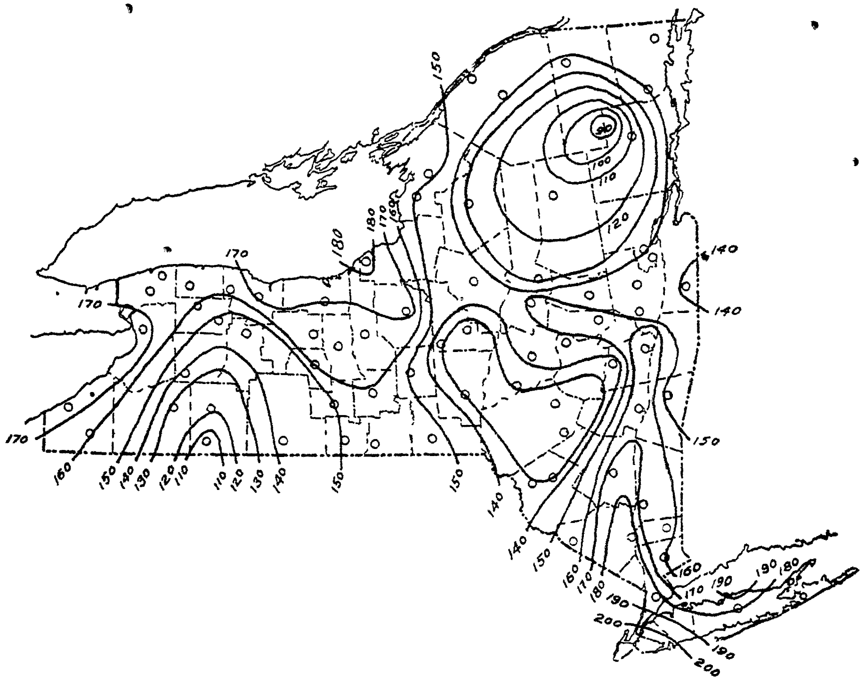


FIGURE 22. AVERAGE LENGTH OF THE GROWING SEASON, IN DAYS

With respect to the average length of the season between frosts, it should be noted that there are perhaps twenty days at either end of the season when frosts are likely to occur, and that the season of complete immunity from frost is about forty days shorter than the average as shown by the chart.

The effect of the Atlantic Ocean, of the Great Lakes, and even of the central lakes, is again very clearly shown by the fact that these sections have a much longer growing season than any of the plateau divisions. The plateau divisions must be content with a frost-free season of from one to two months shorter than that of the lake divisions. Long Island enjoys a growing season which is practically twice as long as in some sections of the Adirondacks.

PRECIPITATION

New York State is supplied with moisture principally by the winds that come from the Gulf of Mexico and from the Atlantic Ocean through the action of cyclonic storms. The general current of the prevailing westerlies plays but a small part in producing the rainfall of the State, except in so far as it accounts for the passage of the low-pressure areas.

The accompanying charts, figures 23 to 35, show the average annual and monthly precipitation. They are based on observations made daily at about sixty-five stations throughout the State. The records vary in length and also in the years covered, but no records covering a period of

less than fifteen years have been used in computing the averages. Several of the records cover a period of more than eighty years; a few, more than fifty years; and many, more than thirty years Different types of rain gauges have been used in the series of records, but it is believed that no serious errors have arisen from this procedure

Precipitation in the form of snow was reduced to its water equivalent by melting the snow and measuring and recording the depth of the water thus obtained. When it was impracticable to melt the snow, the water equivalent was recorded as one-tenth of the actual depth of the unmelted snowfall. If the snow is very wet or very dry, the error in applying this so-called " 1-to-10 rule " is considerable; but when the method is applied to the snowfall of a season, which includes snowfalls of every character, or to those of many seasons, experience has shown that the error, so far as averages are concerned, is not serious.

Examination of the annual-precipitation chart (figure 23) brings out clearly the remarkably wide variation in the average amount of rainfall received in the different divisions of the State. In general, the average rainfall of the eastern half of the State greatly exceeds that of the western half, except possibly for the more elevated parts of Chautauqua and Cattaraugus Counties. For the Central Lakes division, including parts of Livingston, Ontario, and Yates Counties,[2] as well as for the western part of Niagara County and a part of the Champlain Valley division, the annual rainfall is the lightest in the State, slightly less than 30 inches annually. The heaviest precipitation, slightly in excess of 50 inches, is in the lower Hudson Valley division, including parts of Dutchess and Putnam Counties, and along the western slope of the Northern Plateau.

For the State as a whole, the winter season (December, January, and February) is relatively dry. By far the greater part of the State receives less than 9 inches of precipitation calculated as rain during these three months. The driest part of the State during the winter is the Champlain Valley division, with the remarkably low average of less than 5 inches. It is also dry in winter over most of the Central Lakes division. Over the southeastern counties, including Long Island, and over the greater part of the Mohawk Valley division, the winter rainfall is liberal, ranging in amount from 11 to more than 12 inches.

The average precipitation for the months of March, April, and May shows increased amounts and a somewhat more uniform distribution than that for the winter months, but the light precipitation persists over most of the Central Lakes division and over most of the Northern Plateau and adjacent divisions. For Long Island and the southeastern counties, and for most of the Mohawk Valley division, the precipitation is nearly the same as that for the winter months.

The summer (June, July, and August) rainfall is not only greater than that of any other season, but is decidedly more uniform in its distribution. The only parts of the State to receive less than a total of 9 inches during the three summer months are Niagara and Orleans Counties and a narrow belt along the St. Lawrence River. Nearly all the rest of the State receives more than 10 inches, a large part receives more than 11

[2] The location of the various counties of New York State are shown in figure 1, page 3.

inches, and considerable areas, particularly the Eastern Plateau and Western Plateau divisions and the lower Hudson Valley division, receive more than 12 inches, during these three months.

It is interesting to note that the precipitation for Long Island is less in summer than during either the winter or the spring season.

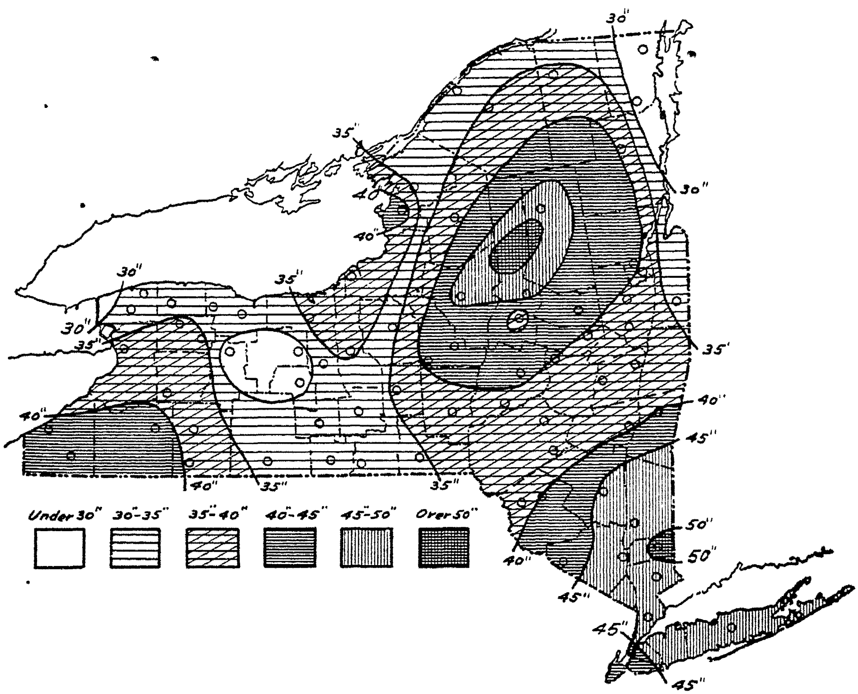
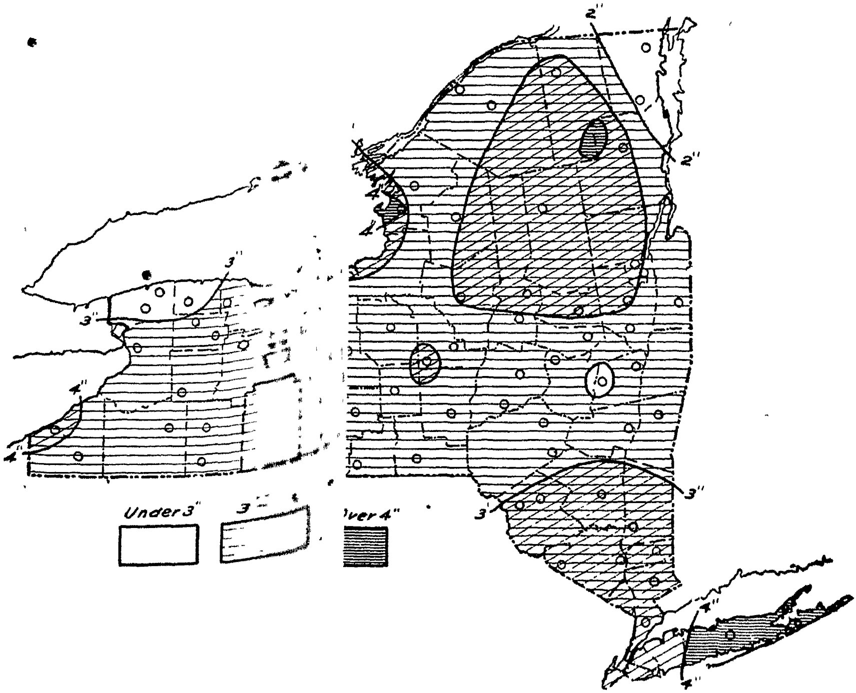


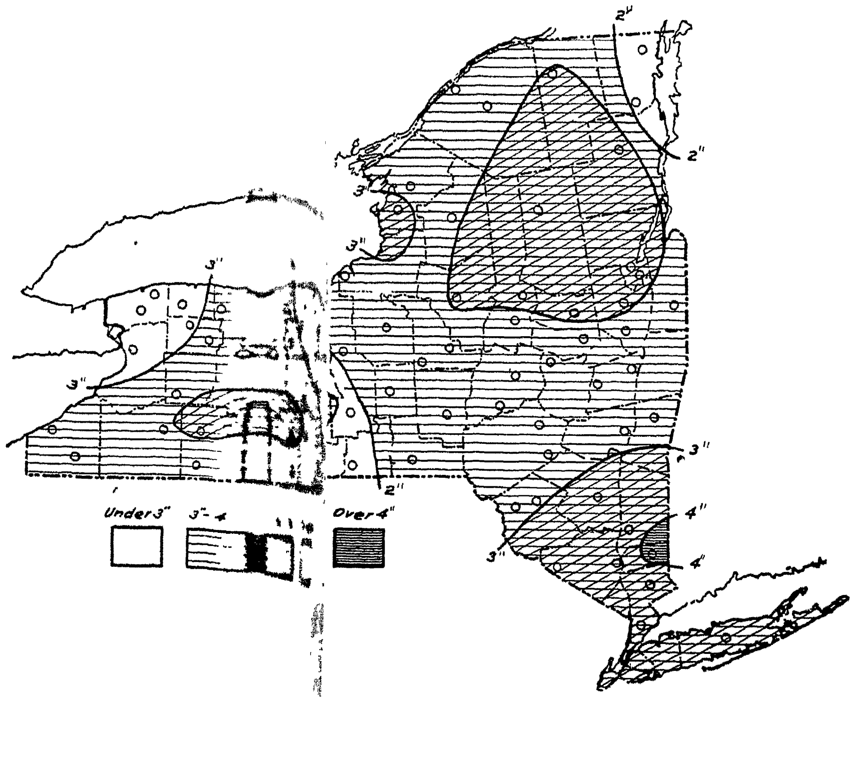
FIGURE 23. MEAN ANNUAL PRECIPITATION

The autumn (September, October, and November) is a season of light rainfall, particularly in the Central Lakes division and along the shore of Lake Ontario. Over all of this region the fall precipitation is less than 9 inches, and over much of it the average is less than 8 inches. Over most of the eastern half of the State the fall precipitation is liberal, ranging generally from 9 to more than 11 inches; a marked contrast to the conditions that prevail over the western half of the State.

In order to bring out more clearly the fact that spring is not the season of greatest rainfall, as is commonly believed, the mean monthly precipitation for the State is shown in table 1. This table indicates that July



IEAN JANUARY PRECIPITATION



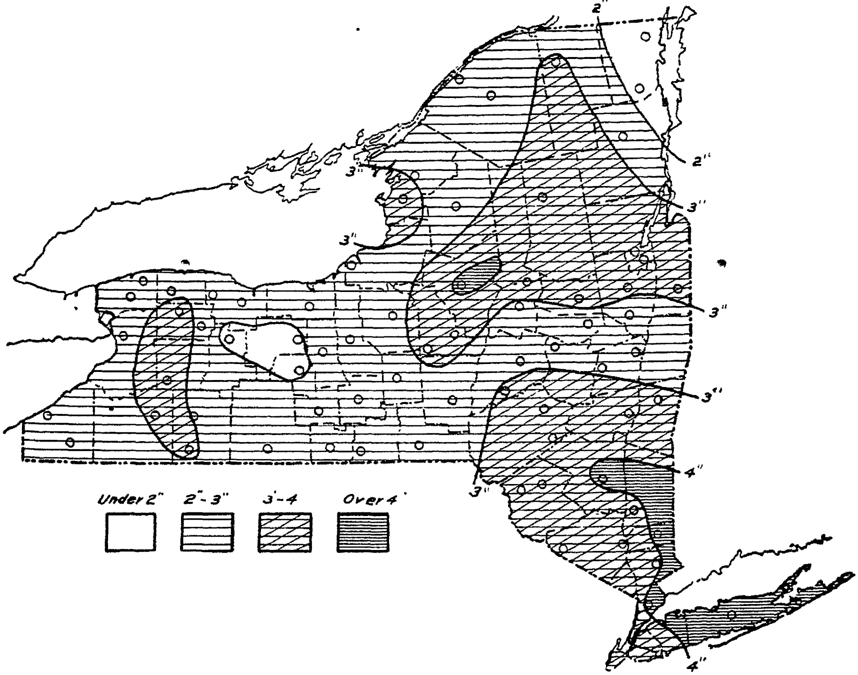


FIGURE 26. MEAN MARCH PRECIPITATION

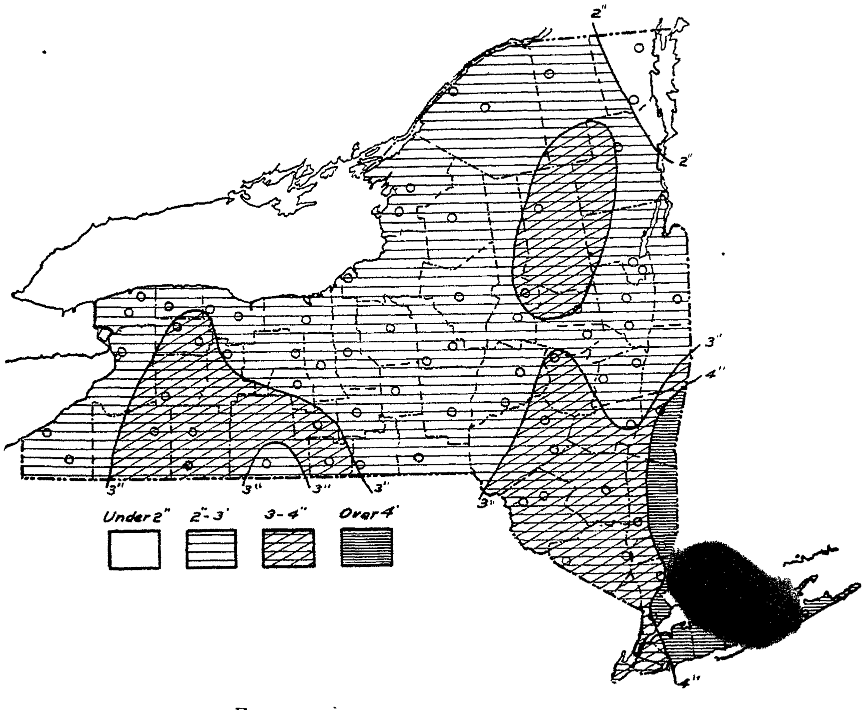


FIGURE 27 MEAN APRIL PRECIPITATION

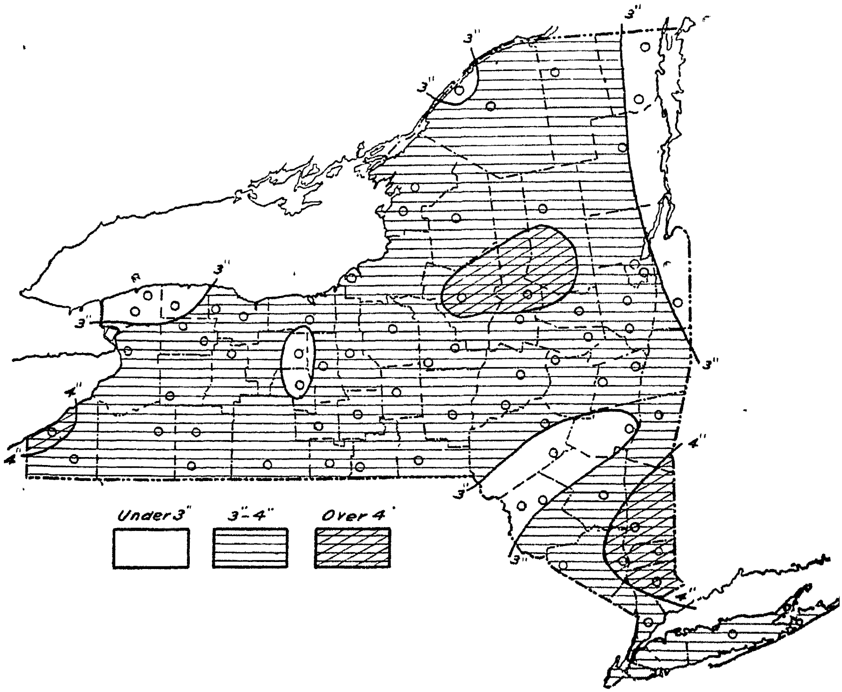


FIGURE 28. MEAN MAY PRECIPITATION

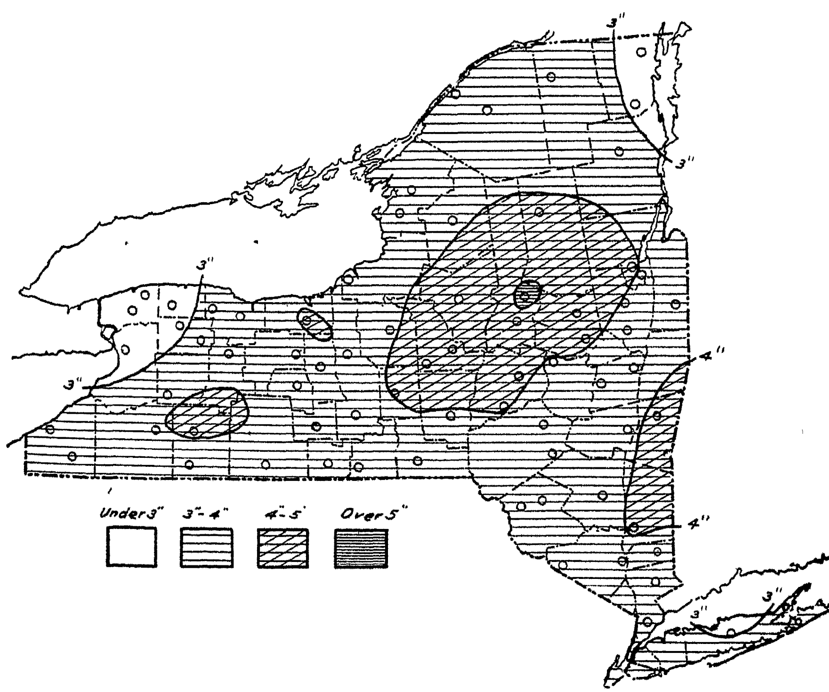


FIGURE 29. MEAN JUNE PRECIPITATION

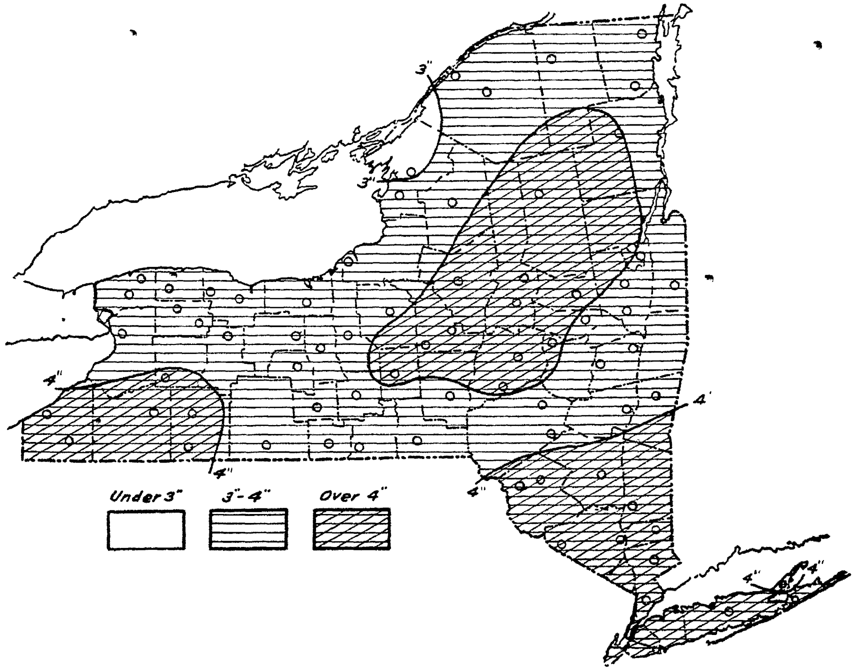


FIGURE 30. MEAN JULY PRECIPITATION

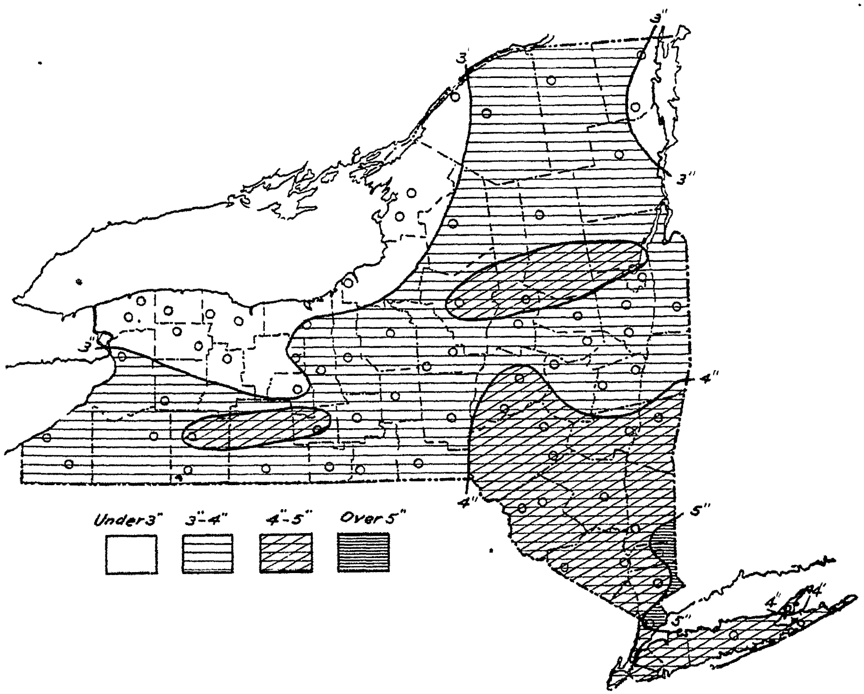


FIGURE 31. MEAN AUGUST PRECIPITATION

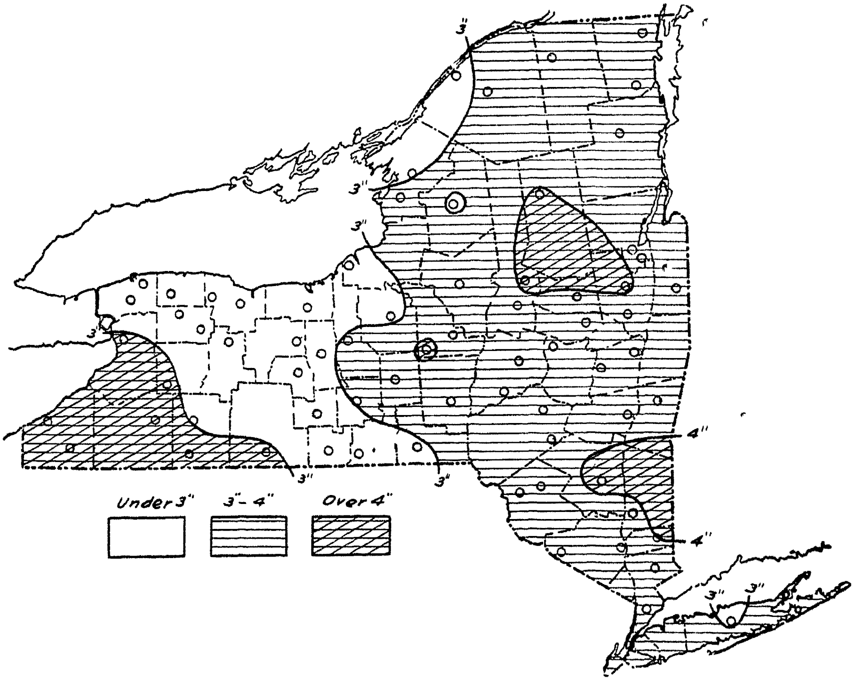


FIGURE 32. MEAN SEPTEMBER PRECIPITATION

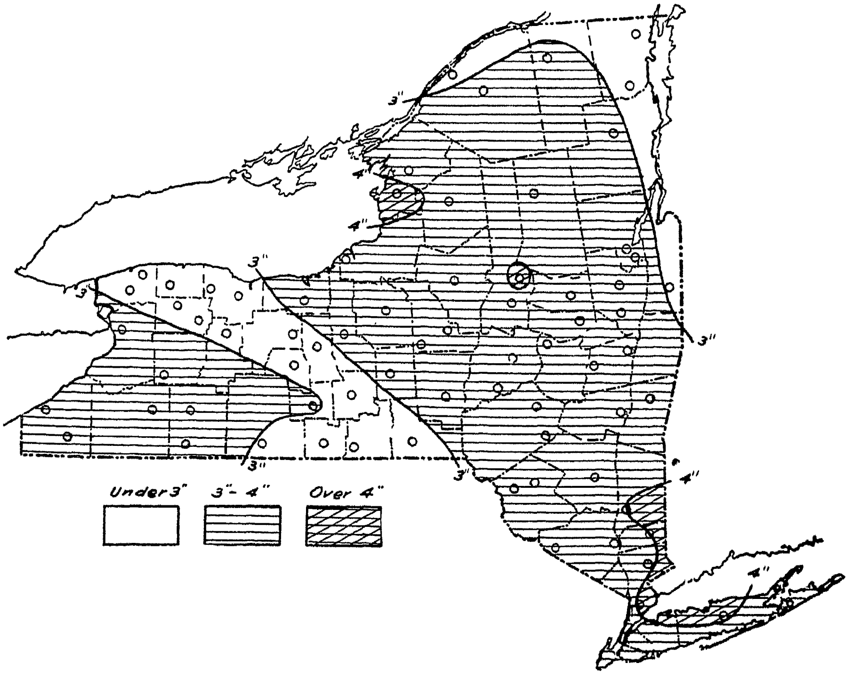


FIGURE 33. MEAN OCTOBER PRECIPITATION

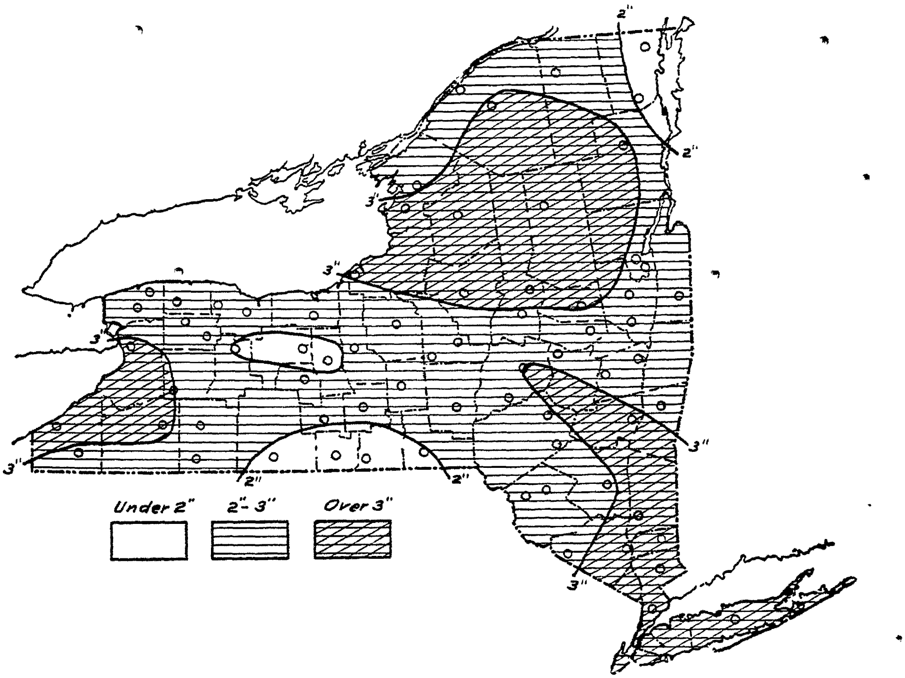


FIGURE 34. MEAN NOVEMBER PRECIPITATION

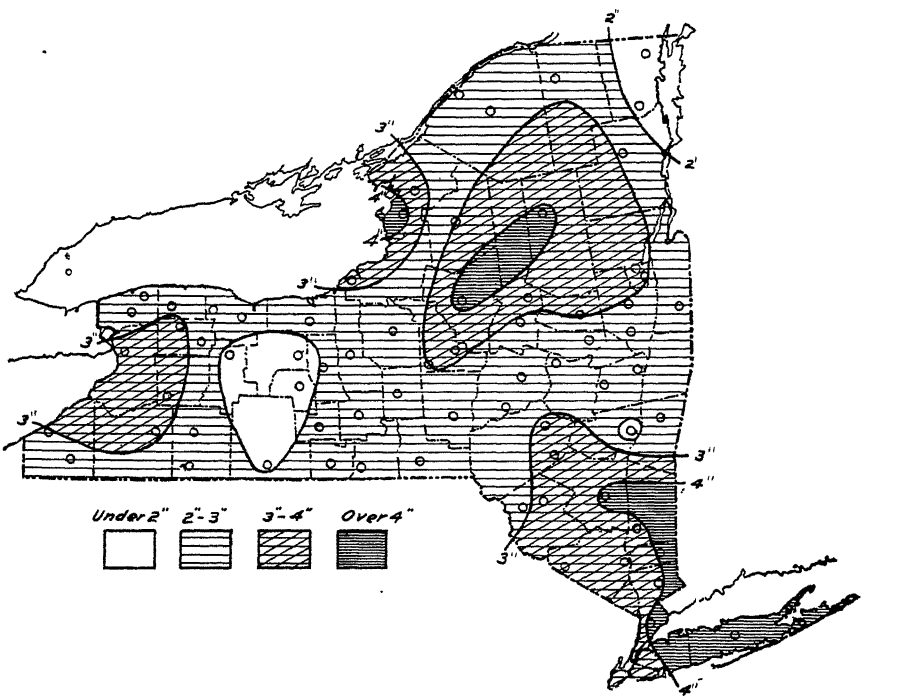


FIGURE 35. MEAN DECEMBER PRECIPITATION

TABLE 1. MEAN MONTHLY PRECIPITATION FOR THE STATE
(Average of sixty-five stations)

Month	Precipitation (inches)	Month	Precipitation* (inches)
January	2.88	July	3.87
February	2 68	August	3.68
March	3.06	June	3 61
April	2.89	May	3.45
May	3.45	October	3 40
June	3 61	September	3.28
July	3.87	March	3 06
August	3.68	December	2 97
September	3 28	April	2.89
October	3 40	January	2.88
November	2.71	November	2.71
December	2 97	February	2 68
Annual	38 48	Annual	38.48

* The same mean monthly precipitation arranged in the order of the heaviest precipitation.

and August, two months which are ordinarily thought of as dry periods, are in reality the two months of heaviest rainfall during the year. The heavy summer precipitation is due largely to thunderstorms, which

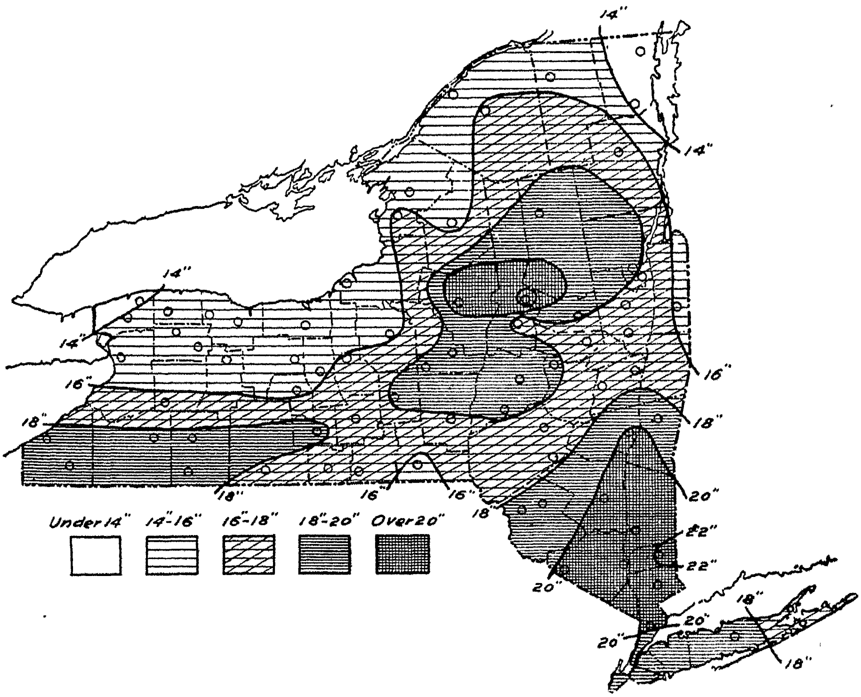


FIGURE 36. MEAN PRECIPITATION FOR GROWING SEASON

usually form quickly, cause heavy rains for a short time, and then pass on leaving the sky clear and the sun shining. April, with its proverbial "April showers," is one of the drier months, having over 25 per cent less rain than has July.

From the foregoing paragraphs, and from the rainfall map for the growing months (figure 36), it will readily be seen that New York State is exceptionally well favored by having a good distribution of rainfall throughout the growing season. This is of much more importance to agriculture than is the total annual rainfall, since moisture is thus furnished for plant growth at the time when it is most needed. Also, the smaller winter precipitation, principally in the form of snow, causes very little erosion or leaching of soil fertility such as would result if the heaviest rains came when crops were not on the ground.

It is often desirable to know the heaviest and the lightest rainfall that has been experienced at different places. The mean, the heaviest, and the lightest annual rainfall, as well as the mean, the heaviest, and the lightest rainfall for the crop-growing season (April to August), for sixty-five stations in various parts of the State, are shown in table 2:

TABLE 2. ANNUAL PRECIPITATION, AND PRECIPITATION FOR THE CROP-GROWING SEASON

Station	Annual			Crop-growing season (April to August)		
	Mean	Heaviest	Lightest	Mean	Heaviest	Lightest
Adams Center...	44.53	65.40	32 82	16.97	27.47	9.98
Addison.... ...	33.79	40.51	25 84	17.73	23.23	10.96
Albany	37.64	56.78	26 39	17.73	35.97	9.34
Amsterdam	38.13	47.27	30 90	17.35	24.60	10.65
Angelica	37.98	52.07	28.02	19 41	25.15	9.71
Appleton........	30.36	53.04	20.60	14.00	28.55	6.97
Athens..........	37.81	48.71	30 55	16.72	22.38	9.27
Auburn...	36.63	49.82	21.74	17.34	24 29	10.33
Avon...	28.67	35.47	19.35	14.78	18.95	7.70
Ballston Lake ..	35.91	45.54	30 07	16.33	25.56	11.72
Bedford Hills....	46.13	68.98	35.36	20.46	39.44	15.89
Binghamton.... .	33.30	42.62	22.42	15.94	24.03	6.38
Bolivar..	39.73	48.64	31.75	19.33	26.97	12.90
Brockport.......	34.14	43.88	26 67	15.82	22.14	7.37
Buffalo......	36 71	60.24	28 11	14.69	27.92	8.05
Canton...	36.78	45.86	27.25	16.32	26.30	11.67
Carvers Falls.....	34.81	42.80	29 26	15.65	19.16	11.71
Chatham....... .	40 52	51.04	26.50	19.79	29.61	11.18
Chazy...........	25.81	35.30	19.39	13.10	19.24	7.24
Cooperstown.. .	40.73	58.11	29 90	19.63	28 58	12.13
Cortland....	39 97	48.41	29 40	19 17	25.05	11.83
Cutchogue..	45.76	57.44	34.70	17.77	24 35	13.06
DeRuyter........	41.09	48.48	34.45	18.97	24.22	13.84
Elba.............	36.98	45.30	30.53	15.87	21.66	9.42
Elmira........ ...	33.69	40.08	25.47	17.50	23.27	9.56
Franklinville.....	41.25	49.60	31.34	19.31	25 48	11.66
Geneva..........	29.08	42.01	19.35	15.47	22.67	9.72
Glens Falls.......	39.53	53.86	31.88	16 75	27.85	8.70
Gloversville.......	43.57	56.62	34.59	19.04	28.54	10.44
Greenfield Center..	39 64	47.84	33.41	16.46	22.27	10.20

TABLE 2 (*concluded*)

Station	Annual			Crop-growing season (April to August)		
	Mean	Heaviest	Lightest	Mean	Heaviest	Lightest
Griffins Corners....	39.35	51.35	30.84	17.69	26.17	10.01
Harkness.......	26.66	39.96	19.62	13.18	18.70	9.13
Ithaca.. . ..	32.99	46.39	21.20	16.19	24.75	8.67
Jeffersonville.. ..	39.49	52.43	34.51	18.13	26.18	10.35
Lake George. ..	42.16	53.86	35.76	18.43	29.91	9.00
Lake Placid Club..	41.71	48.31	37.45	17.61	21.83	15.06
Little Falls...	38.12	46.62	28.74	17.93	23.28	10.86
Lockport...... ...	31.13	46.48	17.57	14.15	23.72	3.78
Lowville	36.23	48.61	26.47	15.67	25.03	10.48
Lyons	36.46	45.66	27.04	16.79	23.42	10.60
Medford..	46.37	56.37	37.87	19.43	25.35	14.69
Mohonk Lake. ...	47.92	60.75	35.14	21.07	36.83	14.10
Moira	37.29	49.35	31.14	15.89	23.36	12.05
New York.........	44.04	58.68	33.17	19.26	30.32	12.87
Ogdensburg ..	31.63	38.81	24.15	14.41	17.25	7.34
Oneonta	38.20	57.64	29.84	18.47	28.99	10.10
Oswego...... ..	36.56	56.16	23.41	14.71	24.85	7.31
Oxford...........	37.97	60.63	29.13	17.83	28.75	11.19
Penn Yan....	28.82	44.36	19.66	14.77	26.87	9.76
Port Jervis........	43.95	60.05	31.90	20.43	31.03	13.97
Raquette Lake....	45.30	55.03	34.73	18.90	29.50	11.79
Rochester.........	33.31	49.89	20.30	14.74	19.57	8.68
Rome.............	48.24	66.84	32.70	20.88	26.93	12.48
Romulus....	31.12	43.20	22.22	15.56	22.55	9.10
Salisbury.........	48.38	59.26	34.29	22.49	29.99	13.90
Scarsdale.........	47.87	59.69	36.25	21.08	31.18	15.18
Setauket....... ...	46.18	59.26	33.57	18.29	34.73	10.64
Sharon Springs*..	39.12	43.80	36.55	18.43	25.24	16.96
Syracuse...	33.76	44.54	26.96	15.73	21.80	10.01
Wappingers Falls..	48.00	82.06	34.65	21.69	47.86	12.16
Watertown..... ..	34.69	44.80	27.19	14.55	24.40	10.56
Wedgewood.	37.20	48.48	29.44	18.66	26.61	11.50
West Berne.......	34.41	44.91	26.08	16.88	24.13	12.84
Westfield....	40.24	50.68	31.39	18.08	23.68	11.71
West Point... ...	46.03	63.56	30.64	20.76	37.75	10.48

* Seven-years record only.

Snowfall

The most serious error in the records is undoubtedly in connection with the measurements of precipitation in the form of snow. This has always been a difficult problem, and even under the most approved methods of calculation there is a considerable error when high winds prevail and there is much drifting. A study of the earliest records for the winter months indicates that, as a rule, the amounts recorded from snow were probably somewhat less than the true readings.

The average annual snowfall for the State as a whole is about 65 inches, but it varies greatly in different parts of the State. The Adirondack Mountains have the heaviest and Long Island has the lightest snowfall, as is shown by figure 37.

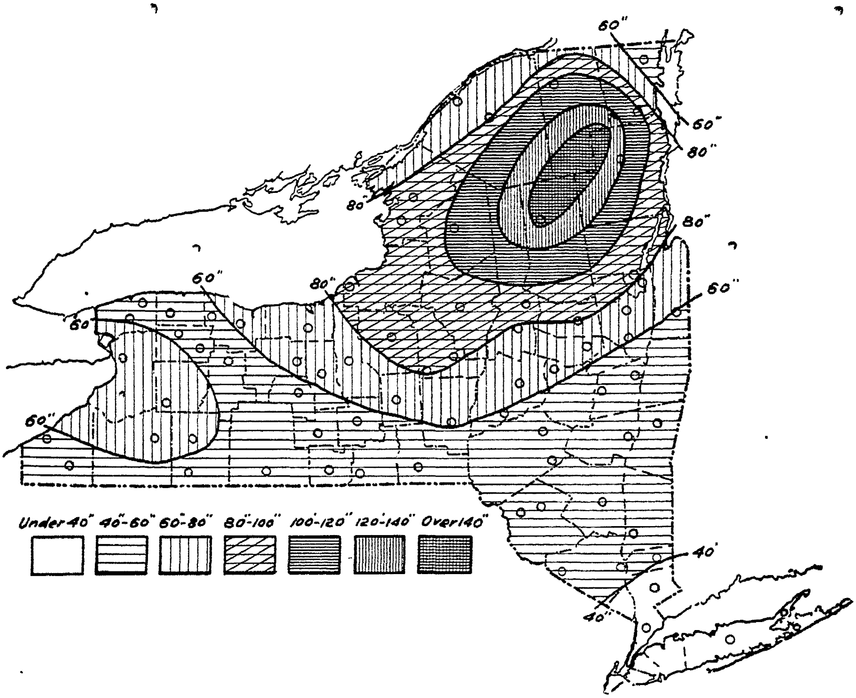


FIGURE 37. MEAN ANNUAL SNOWFALL

Snow occurs usually from October to April, inclusive, but it has been recorded both in May and in September. The greatest average snowfall is in the month of February.

Droughts

A serious and long-continued deficiency of precipitation affecting the State as a whole, is of rare occurrence in New York. There have been many short periods when crops suffered from a deficiency of moisture, and many occasions when a moisture shortage was confined to one or more sections; but there have been only a few state-wide droughts.

Perhaps the two most serious droughts in recent years were those in 1889 and 1908. In 1889 the total rainfall for the months of June, July, and August, which normally is about 12 inches, averaged somewhat less than 6 inches for the entire State, except for the extreme southeastern counties and Long Island, where it was normal or above. As is usual, the western part of the State suffered more than did the eastern part, the total rainfall for the three months in some localities bordering on Lake Ontario being less than 3 inches. The drought of 1908 occurred later in the season, beginning on August 23 and continuing, with the exception of a slight break on September 28 and 29, until October 23, a period of sixty-one days. During a period of thirty-five days, from August 23 to September 27, there were thirteen days on which no rain fell at any of the one hundred and twenty-five recording stations in the

State, and seven days on which there was a light shower at only one station. The water supply for most cities and towns, particularly in the interior, was greatly reduced, and in some places was entirely exhausted.

A drought lasting forty days occurred in April, May, and June, 1903, and another of about fifty days in the same months in 1913. Since they came early in the season, when the loss by evaporation was not great, and since they were followed by copious rains during the latter part of June, the results were not serious.

Thunderstorms

Thunderstorms are more frequent in the Hudson Valley and over Long Island than in other parts of the State, the average number being about twenty to thirty annually. They are also frequent along Lake Erie and Lake Ontario; Buffalo reports as many as fifty-five in a single year. They are less frequent in the northern part of the State and in the interior; the average number reported annually in these sections ranges from six to fourteen.

Hail.— True hail is a product of thunderstorms, but fortunately relatively few thunderstorms produce hail. Of the twenty to thirty thunderstorms that occur annually in the Hudson Valley and over Long Island, only about three or four cause an appreciable fall of hail. For the remainder of the State, hail probably occurs at most places on an average of one or two times in the course of the year, but rarely does it cause any widespread destruction.

TORNADOES

Tornadoes are local whirlwinds of destructive violence, characterized by a funnel-shaped cloud that hangs pendent from the overhanging storm cloud. The path of destruction ranges in width from a few feet to perhaps half a mile, and in length from a few yards to several miles. New York suffers comparatively little from these storms, but no part of the United States east of the 105th meridian may be regarded as entirely secure from their visitation. However, they are more frequent over the Middle-Western and the Southern States than over New York.

Several separate and distinct tornadoes occurred within the State during the year 1888. These storms were widely distributed from the northern to the southern boundary, rather than being confined to the southern tier of counties as is usually the case.

In more recent years, perhaps the most notable storm of this character to visit New York passed over Binghamton at about half past ten o'clock in the evening of June 5, 1905. Its path was from 200 to 600 feet in width and somewhat more than a mile in length. Many trees were uprooted or twisted off, and a number of houses were destroyed; but there was no loss of life.

WINDS

The prevailing winds of the State are westerly, generally shifting toward the north in winter and toward the south in summer. At some points, as Albany, Oswego, and Cooperstown, the southerly winds of

summer persist throughout the fall and even into December and January. At other points, chiefly in the mountainous sections, local topographic conditions control the wind direction, so that the prevailing direction is merely that of a local current. At Ithaca the prevailing direction for the entire year, except in the spring months, is from the southeast, due principally to the trend of the valley at the southern end of Cayuga Lake.

The so-called " night wind " of the Cayuga Lake Valley is interesting, and serves as an example of the effect of local topography. It blows during the summer months at times when the absence of cyclonic disturbances gives full play to local influences. Commonly it sets in a few hours after sunset as a light breeze from the south, gradually increases in strength until a velocity of about eight miles an hour is reached, and thus continues steadily throughout the night. This current has its origin on the hillsides at the southern end of the lake, and it flows northward down the watercourses converging into the main depression. As it moves northward over the smooth surface of the lake, it is augmented by the numerous cool currents which join the main stream through the watercourses that debouch upon the valley from either side.

The night wind is air drainage on a large scale, the result of surface cooling when the heat from the sun is withdrawn. Winds of this character occur in other parts of the State where the local topography is similar.

Observations of wind velocity are available only for the nine regular Weather Bureau stations in the State. The highest velocity for the State, ninety-six miles an hour from the southwest, was recorded at New York City, and velocities of ninety miles an hour, or more, have been recorded at various times.

The highest velocity recorded at Buffalo was ninety-two miles an hour from the southwest, but velocities of ninety miles an hour have been recorded at that station on several occasions. In other parts of the State, velocities exceeding seventy miles an hour are rare.

SUNSHINE

It is obvious that with a clear sky the actual amount of sunshine for any given place would be the number of hours between sunrise and sunset. This is called the *possible sunshine*. It varies greatly with the season, reaching its maximum in June and its minimum in December. It varies also with the latitude, but the variations from this cause within the limits of New York are so slight that, so far as effect is concerned, the possible sunshine for all places within the State may be regarded as essentially the same.

The actual amount of sunshine in hours is recorded automatically at eight Weather Bureau stations in the State, and from the data thus obtained average daily and monthly values have been computed. For the State as a whole, sunshine and cloudiness during daylight hours are about evenly divided, except for the Atlantic Coast division, where the average amount of sunshine is about 60 per cent of the possible. There is less sunshine over the south-central counties than elsewhere in the State. Binghamton has only about 40 per cent of the possible.

New York ranks considerably below the Central and Western States in the amount of sunshine. It lies well within what may be called the

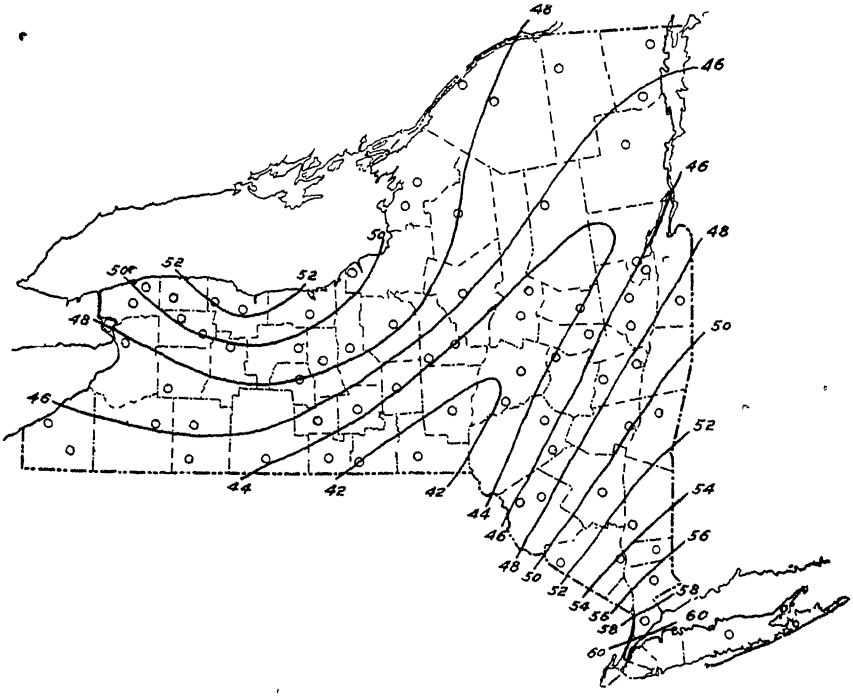


FIGURE 38. ANNUAL SUNSHINE (PERCENTAGE OF POSSIBLE)

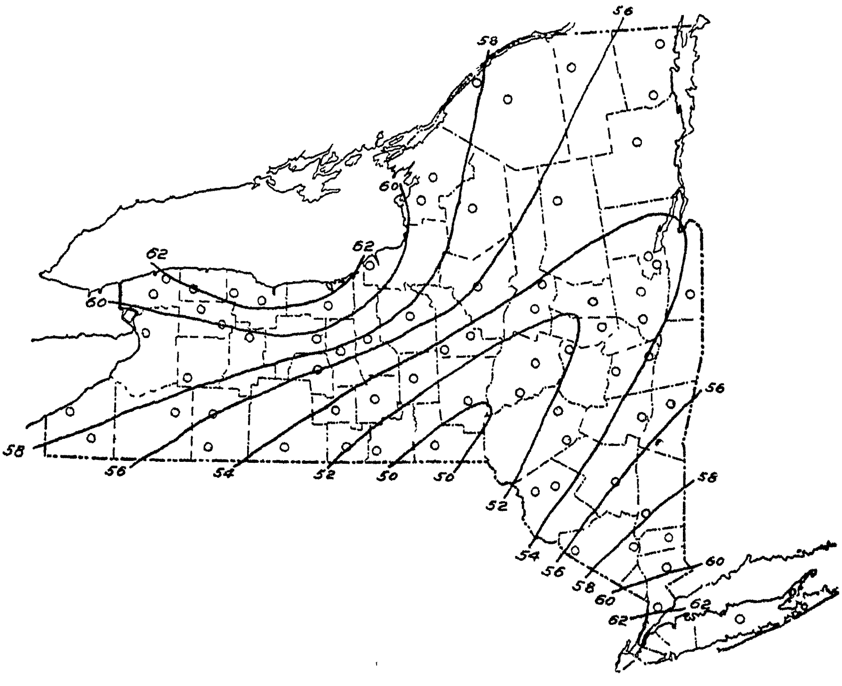


FIGURE 39. MEAN SUNSHINE FOR GROWING SEASON (PERCENTAGE OF POSSIBLE)

eastern cloudy belt, which includes the northern Appalachian Mountains, the Great Lakes region, and northern New England. However, the percentage of sunshine is somewhat higher during the summer months than during the winter months. This is a distinct benefit to the agricultural industries of the State.

The charts of the annual sunshine, and the sunshine during the growing season, are given as figures 38 and 39. These charts clearly show the conditions regarding sunshine throughout the State.

HUMIDITY

The amount of moisture in the atmosphere is usually expressed in terms of relative humidity, or the percentage of moisture in the air as compared with the amount that the air could hold at the same temperature. The capacity of the air for moisture increases rapidly as the temperature increases. Thus the relative humidity would normally be higher during the cooler part of the night than at midday, when the temperature is higher.

The mean relative humidity at eight o'clock in the morning, for the regular Weather Bureau stations throughout the State for the five-years period from 1915 to 1919, is given in table 3. While these figures are for one hour only, and do not necessarily represent the true daily mean, they do indicate that the atmosphere of the State is not deficient in moisture.

CHANGE IN CLIMATE

Many persons think that the agriculture of the State is changing, due to a change in the climate. It is well known that there have been great climatic changes during the past geologic ages, and, in all probability, there will be other changes in ages to come; but such changes are so gradual that they cannot be detected in any of the records at present available. The temperature and precipitation records for Albany, New York, by five-years periods beginning with 1820, are given in table 4. This table shows irregular fluctuations from period to period, but it shows no great change in the climate during the past one hundred and five years. Therefore any change in agriculture or in crop yields should be attributed to some cause other than a change in the climate of the State.

TABLE 3. MEAN MONTHLY RELATIVE HUMIDITY*
(Percentage)

Stations	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean annual
Albany	80.4	79.0	76.0	72.4	69.6	72.2	76.8	77.6	82.0	81.6	77.4	80.4	77.1
Binghamton	84.0	83.4	80.2	80.8	83.2	84.2	84.4	86.2	90.0	87.2	82.4	85.8	84.3
Buffalo	83.4	81.8	79.6	77.8	82.8	74.6	76.4	76.8	78.4	79.2	81.2	83.4	79.6
Canton	87.0	87.0	81.2	77.6	75.0	75.0	75.0	79.2	80.6	83.0	83.2	86.0	80.8
Ithaca	81.8	82.4	78.4	74.6	72.8	74.4	77.0	80.0	79.8	80.0	78.2	82.7	78.5
New York	68.0	67.0	64.4	65.8	68.0	73.2	76.2	77.0	75.6	75.6	70.0	71.6	71.0
Oswego	84.6	85.8	79.2	77.8	76.0	76.8	76.8	77.8	78.2	78.4	77.6	84.8	79.5
Rochester	79.4	76.6	71.6	70.0	69.6	70.0	72.4	75.2	76.2	77.0	74.4	77.2	74.1
Syracuse	80.8	81.2	76.4	71.2	70.2	74.4	79.2	78.6	79.0	77.0	78.0	82.4	77.4

* Five-years average (1915–1919).

TABLE 4. EARLY RECORDS AT ALBANY, NEW YORK

Period	Temperature (degrees Fahrenheit)			Precipitation (inches)		
	January	July	Annual	January	July	Annual
1820–24	21.8°	72.6°	48.5°	......	.....	......
1825–29	25.0°	72.8°	50.0°	3.66	4.89	39.66
1830–34	24.2°	72.6°	48.8°	2.37	4.18	40.01
1835–39	23.2°	71.8°	46.4°	3.72	3.94	41.48
1840–44	23.8°	71.9°	48.1°	2.30	3.22	42.14
1845–49	26.0°	73.0°	49.3°	2.46	4.44	41.12
1850–54	24.9°	72.8°	48.3°	2.07	4.52	39.66
1855–59	23.5°	72.0°	46.8°	2.14	4.17	37.90
1860–64	25.2°	71.9°	47.2°	3.02	4.71	35.45
1865–69	18.4°	74.6°	46.8°	2.31	3.11	38.97
1870–74	28.7°*	73.4°*	47.8°*	3.08	6.98	45.81
1875–79	19.4°	71.6°	46.5°	2.53	4.41	40.11
1880–84	23.9°	73.1°	50.1°	2.77	4.19	36.18
1885–89	22.4°	73.1°	47.7°	3.13	3.17	38.45
1890–94	24.5°	72.0°	48.4°	3.44	3.62	38.38
1895–99	23.0°	73.5°	49.0°	1.94	3.60	33.23
1900–04	22.4°	72.9°	48.1°	1.79	3.90	34.78
1905–09	25.1°	73.0°	48.1°	1.94	3.42	29.90
1910–14	24.7°	73.3°	48.6°	2.18	2.33	29.78
1915–19	24.9°	72.9°	48.0°	2.04	3.13	33.16
1920–23	20.4°	72.4°	49.1°	2.26	3.65	34.68

* Temperature for two years only.

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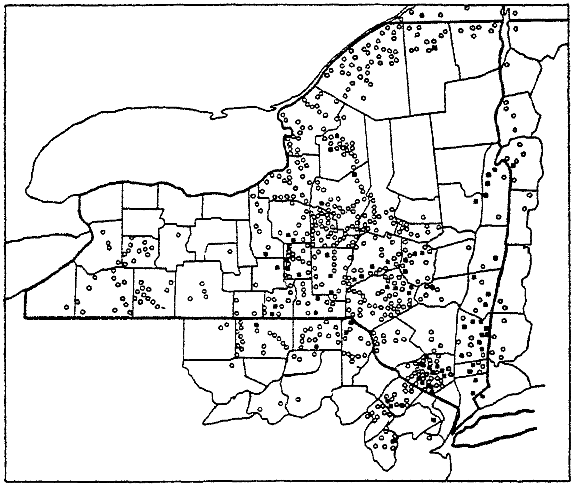
Bulletin 445 November, 1925

A Preliminary Survey of Milk Marketing in New York

L. J. Norton and Leland Spencer



LOCATION OF COUNTRY PLANTS THAT SUPPLY NEW YORK CITY WITH MILK AND CREAM

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CONTENTS

A PRELIMINARY SURVEY OF MILK MARKETING IN NEW YORK[1]

L. J. NORTON AND LELAND SPENCER

The purpose of this bulletin is to report the results of a preliminary study of some economic problems related to the marketing of milk in the New York territory. It is not intended to show the results of any completed piece of research, but rather to bring together some fundamental facts that may serve as the basis for more detailed studies.

THE NEW YORK MARKET

The New York milk market includes, besides the five boroughs of Greater New York, the following places: Yonkers and Mount Vernon, in New York; Jersey City, Hoboken, Newark, Paterson, and Elizabeth, in New Jersey; and the towns between these places. The population of this whole district in 1924 was about 8,700,000.

TREND OF CONSUMPTION OF MILK AND CREAM

Records of the quantities of milk and cream delivered at the New York market have been published monthly for many years by the *Milk Reporter*. These statistics are compiled from reports furnished by the railroads, with an allowance of 1000 cans a day for milk brought in by motor trucks. No milk nor cream is reshipped to other places, except that which is used on the ships leaving the Port of New York or on the dining cars of outgoing trains. These uses, however, account for only a small proportion of the total quantity of milk and cream delivered at the metropolitan terminals. Some milk and much cream[2] are used in the manufacture of ice cream in the New York market, but there is little manufacturing of other dairy products.

The average quantities of milk and cream received daily at the New York terminals each year since 1885 are shown graphically in figure 1.[3] The receipts of milk have increased every year since the records have been kept. In 1885 the average quantity of milk received daily at the New York market was 13,508 forty-quart cans; the daily average for 1924 was 81,685 cans, or more than six times as much.

The receipts of cream have increased more than the receipts of milk, but they have been more irregular. In 1885 the daily average receipts of cream were 471 forty-quart cans, and in 1924 the receipts averaged 4731 forty-quart cans a day, or ten times as much. Decreases occurred in 1896 and 1897, in 1907 and 1908, and in 1917 and 1918.

[1] The investigational work on which this bulletin is based was conducted by the authors under the supervision of the Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C., and the Department of Agricultural Economics and Farm Management, New York State College of Agriculture at Cornell University, Ithaca, New York. The New York State Department of Farms and Markets, and Borden's Farm Products Co., Inc., cooperated in furnishing a large amount of statistical material covering the production and utilization of milk in the State.

[2] Plain condensed milk shipped in forty-quart cans is included in the figures given for cream.

[3] Monthly receipts are given in the appendix, tables 13 and 14, pages 40 and 41.

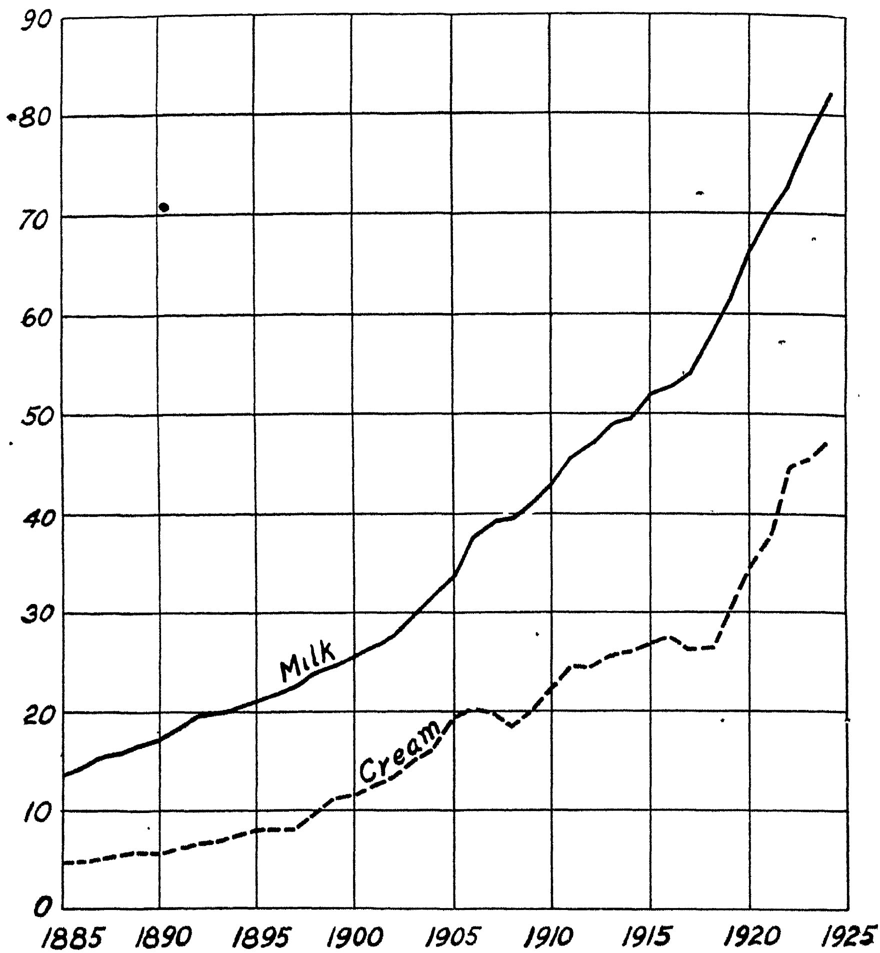

FIGURE I. AVERAGE DAILY RECEIPTS OF MILK AND CREAM AT THE NEW YORK MARKET ANNUALLY, 1885–1924

The figures for milk represent thousands of 40-quart cans, and those for cream represent hundreds of 40-quart cans. The receipts of milk and of cream correspond closely with the consumption of these products in the New York market

CONSUMPTION PER CAPITA

Milk and cream receipts at the New York market have increased much faster than has the population. In 1890 the receipts of milk amounted to 74 quarts per capita, as compared with 137 quarts per capita in 1924. Cream receipts increased from 2.4 quarts per capita in 1890 to 8 quarts per capita in 1924 (table 1).

During this thirty-four-years period, the consumption of milk per capita increased 85 per cent and the consumption of cream per capita more than tripled.

The improved quality of the milk supply has probably been as important a factor as any in stimulating greater use of milk and cream. New York

TABLE 1. Population, and Annual Consumption of Milk and Cream, in the New York Market

Year	Approximate population (thousands)	Forty-quart cans of milk (thousands)	Quarts of milk per capita	Forty-quart cans of cream (thousands)	Quarts of cream per capita
1890	3,388	6,279	74.1	206	2.4
1900	4,701	9,389	79.9	423	3.6
1910	6,609	15,820	95.7	816	4.9
1920	7,975	24,395	122.4	1,270	6.4
1924	8,700	29,897	137.5	1,732	8.0

City is now said to have the best milk supply of any large city in the world. The milk delivered by the larger milk-distributing organizations, at least, is uniformly pure, fresh, and of good keeping quality. This was not true twenty years ago.

An increase in the proportion of the heavier milk-consuming races in New York, particularly the Semitic race, is undoubtedly an important cause of the increased consumption per capita.

Various demonstrations and other means of publicity have convinced a large proportion of the people of the value of milk as a food. Milk is a cheaper source of animal protein and energy than is meat. Recognition of its high food value has probably resulted in the substitution of milk (and cream) for meat to a considerable extent. The per-capita consumption of meat and lard in the United States decreased from 172 pounds a year in the period from 1907 to 1911, to 158 pounds a year in the period from 1918 to 1922.[4]

Since 1918, prohibition has stimulated the use of milk as a drink. The remarkable expansion of the ice-cream business is due, in part, to the same cause, and accounts for a large share of the increase in cream receipts in recent years.

SEASONAL VARIATION IN CONSUMPTION

The quantity of milk and cream received at the New York market varies with the season (figure 2). About 20 per cent more milk and about twice as much cream are received in June as in December. Considering the quantity of milk necessary to supply both milk and cream for this market, nearly 50 per cent more is needed in June than in December. Some cream is stored during the period of heaviest receipts. Consumption probably is somewhat less than the receipts in April, May, and June, and somewhat greater than the receipts during the latter part of the year. The demand for milk and cream is least in November, December, January, and February. Consumption increases during March, April, and May, reaches the peak in June, and then gradually declines during the remainder of the year.

This seasonal variation in consumption is the result of two principal causes: temperature, and the number of people in the cities. Consumption increases with rising temperature during the spring months. The

[4] U. S. Agr. Dept. Yearbook 1922:811.

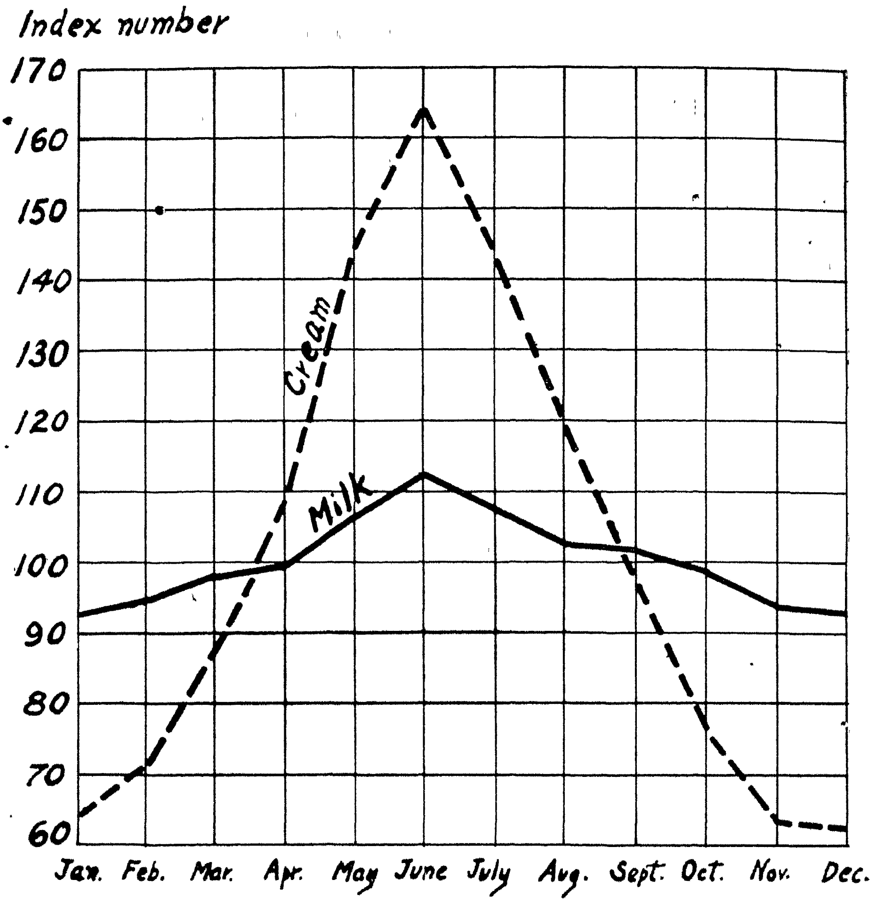

FIGURE 2. SEASONAL VARIATION IN RECEIPTS OF MILK AND CREAM AT THE NEW YORK MARKET

(Daily average for the five years from 1920 to 1924 = 100. Secular trend removed)
Consumption of milk and cream increases as the temperature rises in the spring, but falls off in July and August when many city people go to the country for vacation

temperature remains high during July and August, but so many people leave the metropolitan district during these months that the net effect is a decrease in consumption. Most vacations are over by the beginning of September, but the temperature is then falling, so that the net effect is a continued decrease in consumption.

Since in summer more milk is used for drinking and more cream is used for ice cream than was formerly used for these purposes, the consumption has increased slightly more in summer than in winter.[5] A change in the schedule of retail prices may have had some influence in the same direction. Previous to 1916, the retail price of milk in New York was

[5] Index numbers of seasonal variation in the receipts of milk and cream are given in the appendix, table 15, page 42.

held constant thruout the year. Since 1916, the price has been changed several times each year, and has been somewhat lower in summer than in winter.[6]

TEMPORARY FLUCTUATIONS IN CONSUMPTION

The temporary, or short-time, variations in milk and cream receipts are illustrated in figure 3.[7] It is noticeable that the cream receipts fluctuate much more than do the milk receipts. The consumption of

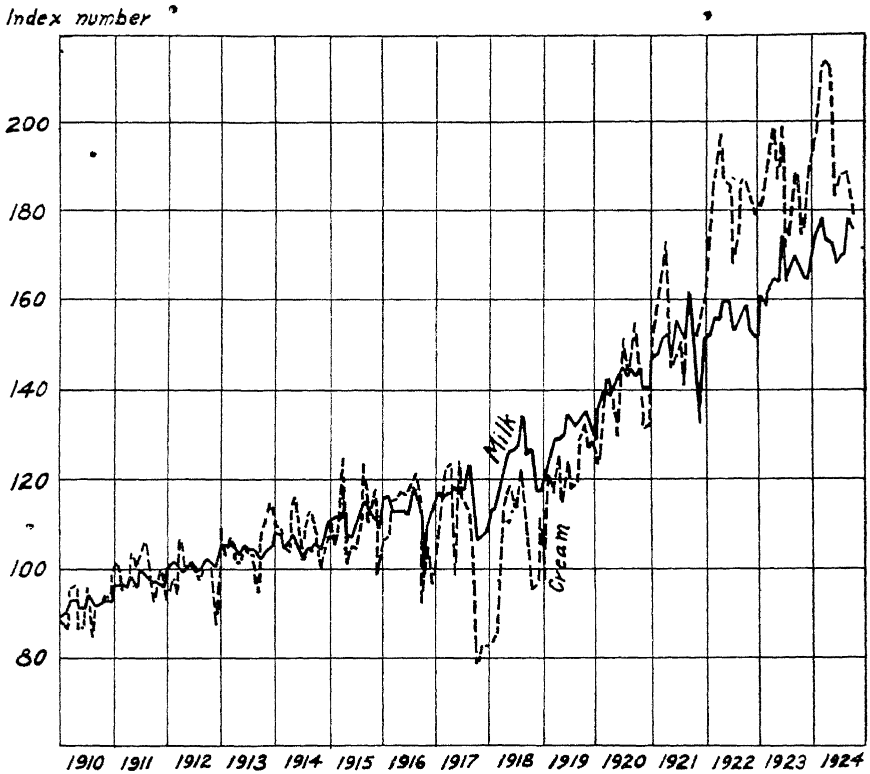

FIGURE 3. INDEX NUMBERS OF MONTHLY RECEIPTS OF MILK AND CREAM AT THE NEW YORK MARKET, 1910–1924

(Average receipts for the corresponding months in the five-years period from 1910 to 1914 = 100)

The milk and cream receipts vary considerably from month to month and also from day to day. Changes in temperature are the chief cause of these variations

cream is affected more by economic conditions. The decreased consumption of cream during 1907 and 1908 (figure 1) was coincident with a financial panic and considerable unemployment. Another decrease in 1917 and 1918 was probably due to the rising costs of living as wages lagged. The reverse of this condition prevailed from 1920 to 1924, when wages remained at a high level and living costs decreased. The average

[6] New York State Coll. Agr., Dept. Agr. Econ. and Farm Mgt. Farm Economics, December, 1924, p. 202.

[7] Index numbers of monthly receipts of milk and cream are given in the appendix, tables 16 and 17, pages 42 and 43

weekly wages of factory workers in 1924 would buy about one-third more milk at retail than the wages in 1914 would have bought.[8]

Changes in temperature are the chief cause of the smaller variations in consumption from month to month.[9] The sharp decrease in the receipts of milk and cream in October, 1916, was caused by a strike of the milk producers. A strike of the New York milk-wagon drivers in November, 1921, accounts for another sharp decrease in consumption.

To allow for these variations in the demand for milk, it is necessary for the milk-distributing organizations to handle a supply larger than they actually distribute as fluid milk or cream. The handling of this necessary surplus constitutes an important element in the cost of distributing milk.

THE MILK-SHIPPING AREA

EXTENT OF THE AREA

The New York market obtains over 80 per cent of its supply of milk from New York State, and most of the remainder from adjoining counties

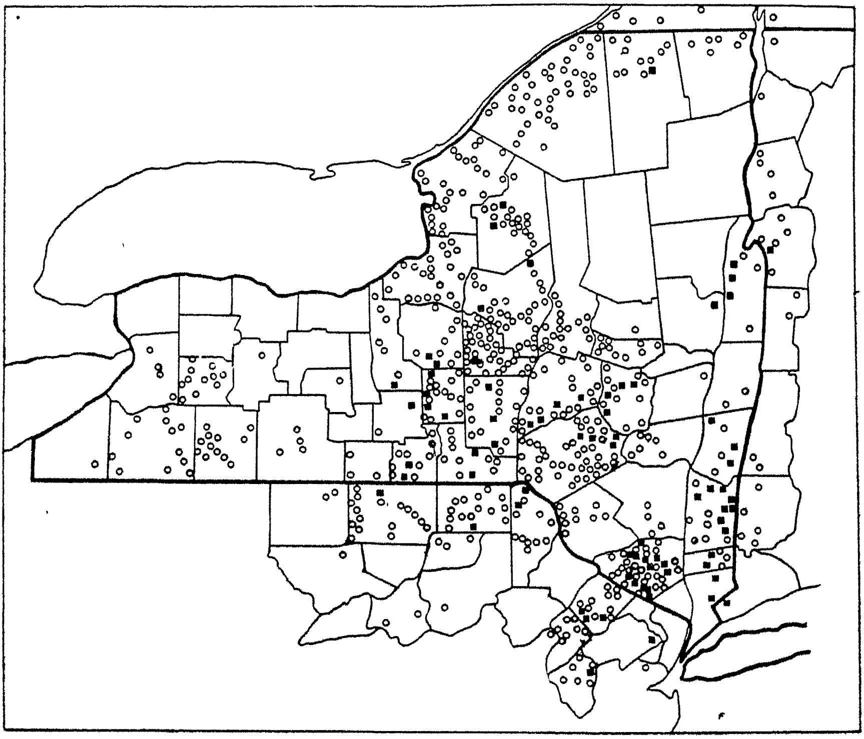

FIGURE 4. LOCATIONS OF COUNTRY PLANTS APPROVED BY THE NEW YORK CITY DEPARTMENT OF HEALTH AS SOURCES OF MILK AND CREAM FOR THE CITY

(Grade A sources are represented by solid black squares, and Grade B sources by circles)

in Vermont, New Jersey, and Pennsylvania. The general outline of the milk-shipping area is indicated in figure 4. The country plants shown in

[8] The purchasing power of New York factory wages in terms of milk is given in the appendix, table 18, p. 43.
[9] New York State Coll. Agr., Dept. Agr. Econ. and Farm Mgt. Farm Economics, June, 1925, p. 298.

this figure are approved by the New York City Department of Health as sources of milk and cream for the city. A considerable number of plants that ship milk and cream to New Jersey cities are located in the same area but these are not shown in the figure. A few approved plants are located at more distant points, but they contribute relatively little milk or cream to the New York market.

Most of this area is naturally adapted to dairying, and it would undoubtedly be an important dairy region even if it were not tributary to large city markets. There is a great diversity of conditions thruout this territory. The important differences related to the production of milk for the city markets are in topography, length of the growing season, type of soil, and railroad connections. These variations affect the intensity of milk production, the season of production, and the way in which the milk is utilized.

DIFFERENCES IN INTENSITY OF DAIRYING

Variations in the intensity of dairying in different parts of the area are indicated by the quantity of milk produced per acre of farm land (figure 5).[10]

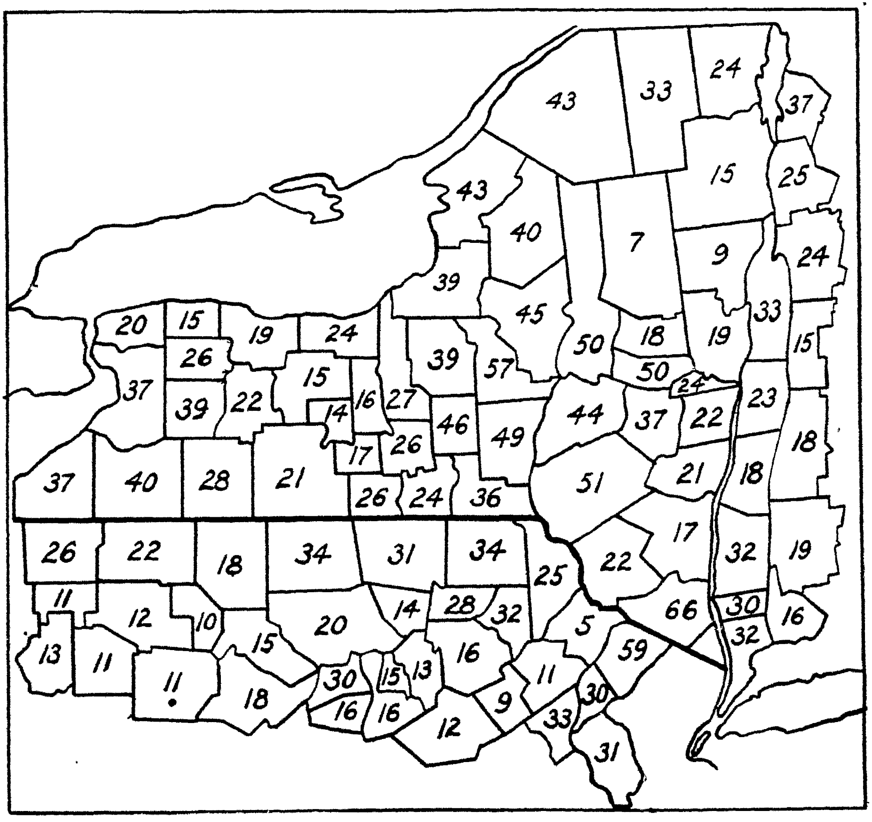

FIGURE 5. GALLONS OF MILK PRODUCED PER ACRE OF LAND IN FARMS, 1919

The regions where dairying is more intensive are the more desirable sources of market milk

[10] Computed from statistics given in the fourteenth census of the United States, vol. 6, Agriculture, part 1 (1919).

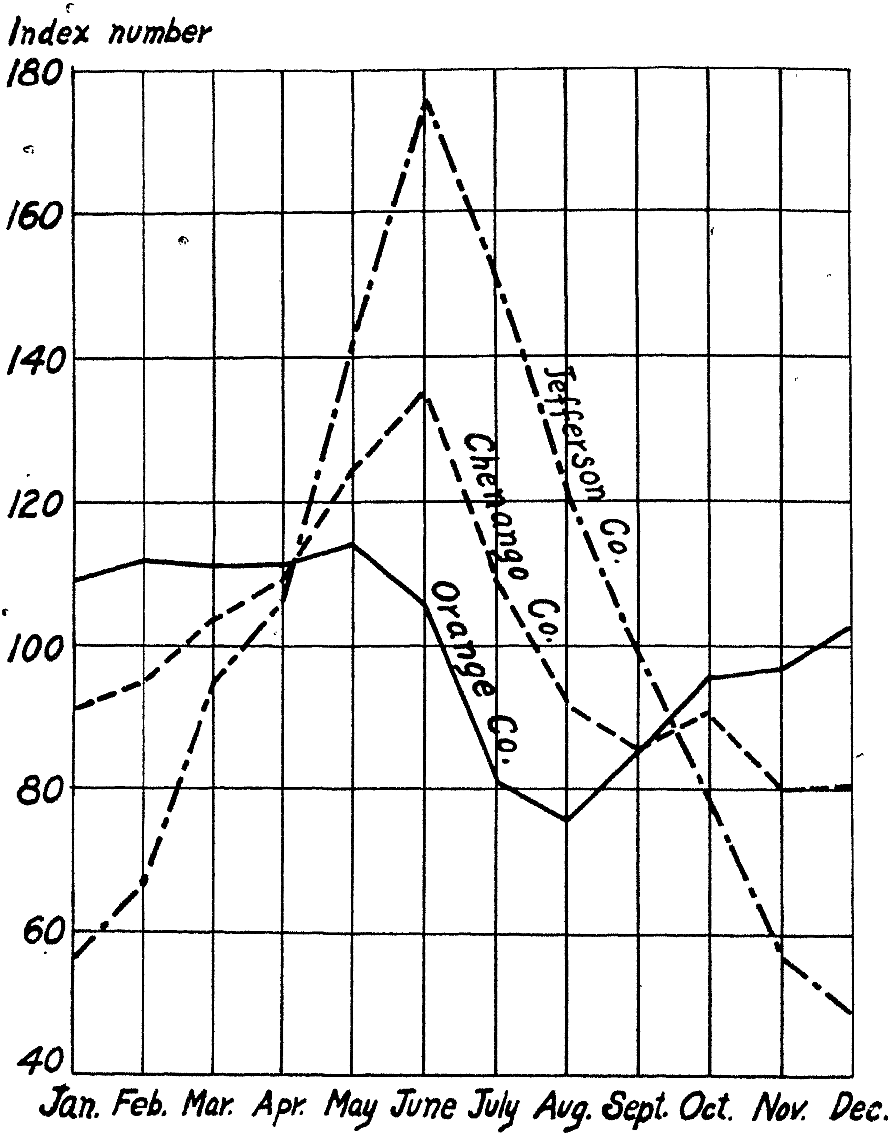

FIGURE 6. SEASONAL VARIATION IN MILK RECEIPTS AT COUNTRY SHIPPING STATIONS, 1922–1923

(Average daily receipts for the two-years period = 100)

Naturally, cows freshen in the spring, but in the counties that have shipped market milk for many years the high winter prices have encouraged breeding for fall freshening. In Orange County, nearly all the cows freshen in the fall; in Jefferson County, nearly all freshen in the spring; and Chenango County has a mixture of summer and winter dairies

Dairying is most intensive in the region extending from St. Lawrence County, in northern New York, southeast thru Madison, Delaware, and Orange Counties. In Montgomery, Herkimer, Madison, Delaware, and Orange Counties, New York, and in Sussex County, New Jersey, 50 gallons

or more of milk are produced per acre. Few milk-shipping stations are located in counties where less than 30 gallons of milk are produced to the acre of farm land.

DIFFERENCES IN SEASONAL DISTRIBUTION OF MILK PRODUCTION

The seasonal distribution of milk production is affected by the present and the previous use of the milk, by the relative amount and productivity of the crop land, and by the relative amount and productivity of the pasture land.

In the older market-milk districts, the comparatively high prices paid for milk in the winter months have encouraged winter dairying. A relatively large acreage and good yields of crops favor winter dairying, since less time is available for work on cows in summer, and since more roughage is usually available for winter feeding. Summer dairying is favored by large areas of good pasture. Some differences in the seasonal distribution of milk production are illustrated in figure 6.

In Orange County, an old market-milk district, winter dairying predominates. Most of the cows freshen in the fall and production is relatively high thruout the winter, increasing slightly in May, when the cows are put on pasture. From the May peak, production declines until August, when the lowest point is reached. From this point, production gradually rises to the high rate which prevails during the winter months.

Until recently a comparatively small amount of market milk was shipped from Jefferson County. The price of milk in this region has been based largely upon the value of milk for making cheese. The climate and the soil here are not especially well adapted to the growing of crops, particularly of silage corn, but the pastures are good. There is little winter dairying. Most of the cows freshen in the spring, and the peak of production comes in June while the pastures are at their best.

Market milk has been shipped from Chenango County for many years, but, since this region is more than 200 miles from New York, a large proportion of the milk has been used for the manufacturing of dairy products. The extensive areas of fertile crop land encourage winter dairying in the valleys, but on the hills summer dairying is the rule. Chenango County as a whole ranks about midway between Jefferson and Orange Counties in the degree of seasonal variation in milk production.

In none of these districts does the seasonal variation in production correspond exactly with the seasonal variation in receipts of milk at the New York market. The relatively large production of milk in the more distant areas in late summer supplements the deficient production in the older market-milk districts at that season.

DIFFERENCES IN THE UTILIZATION OF THE MILK

The utilization of the milk in different parts of the area depends particularly upon the distance from market, the intensity of milk production, and the shipping facilities. Reliable data concerning the utilization of milk are available only for the counties of New York State, but, in general, the utilization of milk in other counties of the shipping area is similar to that in the adjoining New York counties.

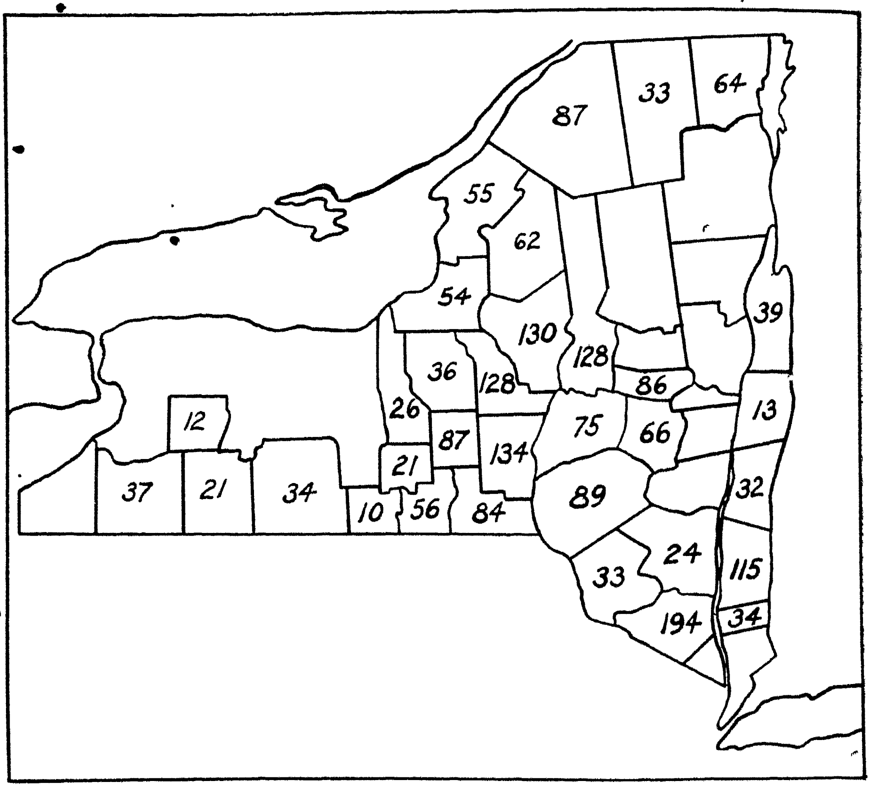

FIGURE 7. MILLIONS OF POUNDS OF MILK SHIPPED BY COUNTRY PLANTS TRIBUTARY TO THE NEW YORK MARKET, 1923

(For counties shipping less than 10,000,000 pounds of milk to the New York market, the figures are omitted)

These figures show the relative importance of the several counties of New York as sources of fluid milk for the New York City market. The names of the counties are given in figure 16, page 44

Areas that ship milk

The approximate quantities of fluid milk shipped from the different counties in 1923 are shown in figure 7. The more intensive dairy counties, and those having good railroad connections for New York, are the chief shippers of milk. In some of the more distant counties, such as Cattaraugus, Wyoming, and Allegany, in western New York, and Jefferson, St. Lawrence, and Franklin, in northern New York, the shipments of fluid milk represent a relatively small part of the total production. The high freight costs make the fluid-milk market less attractive in these counties than in others. Local markets take a large proportion of the milk produced in Rensselaer, Albany, Schenectady, Saratoga, and Onondaga Counties.

Areas that ship cream

The principal sources of cream shipments are shown in figure 8. In Delaware, Greene, and parts of adjoining counties, a large part of the

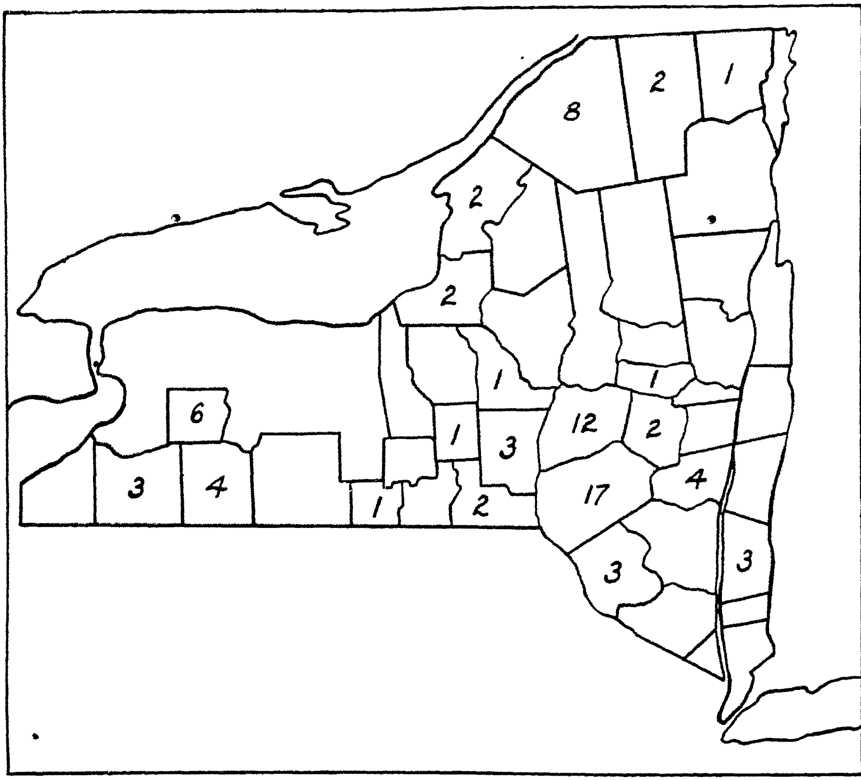

FIGURE 8. MILLIONS OF POUNDS OF CREAM SHIPPED BY COUNTRY PLANTS TRIBUTARY TO THE NEW YORK MARKET, 1923

Cream can be shipped long distances at moderate cost. The New York market draws a large proportion of its cream supply from the outer parts of the milk-shipping area, from the middle-western States, and from Canada

milk is shipped as cream, altho these counties are relatively near the market. Much of this area is not easily accessible to railroad shipping points. Until recently much of the milk was used for making butter, and the cows were selected to produce milk high in butterfat. Most of the milk was produced in summer. With improved roads and the use of motor trucks, some parts of the region are now better able to make regular shipments, but because of the high butterfat test, the shortage of milk in winter, and the smaller cost of hauling cream to the shipping points, it is more advantageous to ship cream than milk. Jefferson and St. Lawrence Counties, in northern New York, are also important sources of cream for the New York market. Wyoming, Allegany, and Cattaraugus Counties, in western New York, ship cream to New York, Buffalo, and Philadelphia. From the more remote sections, milk can be shipped much more cheaply as cream than as whole milk. About ten cans of 4-per-cent milk are required for one can of 40-per-cent cream. The cost of ship-

ping a forty-quart can of cream from Gouverneur, in northern New York, to New York City is 70 cents, while the cost of shipping ten cans of milk is $5.60.

Manufacturing areas

In all parts of the territory, some milk is used for manufacturing dairy products. In the counties nearer the market, manufacturing is limited to the small temporary surpluses at shipping stations, and to communities that are not easily accessible to railroad shipping points or where the volume of milk is too small to justify the operation of a shipping station. Manufacturing of dairy products is carried on more extensively in the more distant counties.

About 14 per cent of the milk delivered to the country plants in New York State is made into cheese. The important cheese-producing counties are shown in figure 9. American cheese is an important product in St. Lawrence, Jefferson, Lewis, and Oswego Counties, in northern New York, and in Steuben, Allegany, Cattaraugus, and Chautauqua Counties,

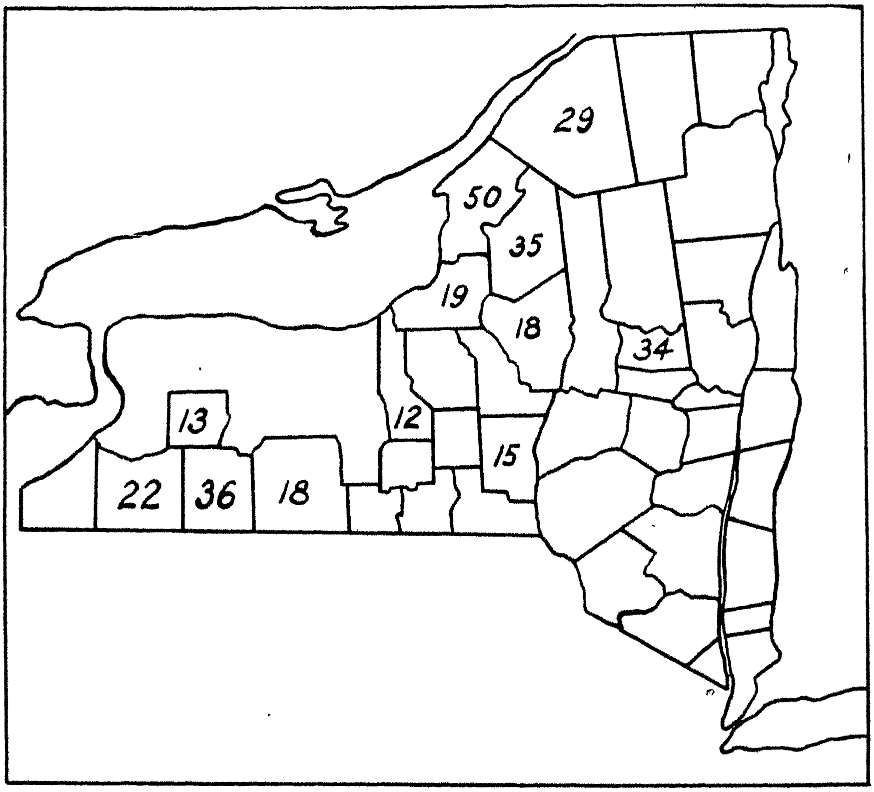

FIGURE 9. PER CENT OF MILK USED BY COUNTRY PLANTS FOR MAKING CHEESE, 1923

(For counties using less than 10 per cent of their milk for making cheese, the figures are omitted)

Excluding cream, cheese is the principal surplus-milk product of this region. It is made chiefly in the more remote counties, where milk is cheap and the summers are cool

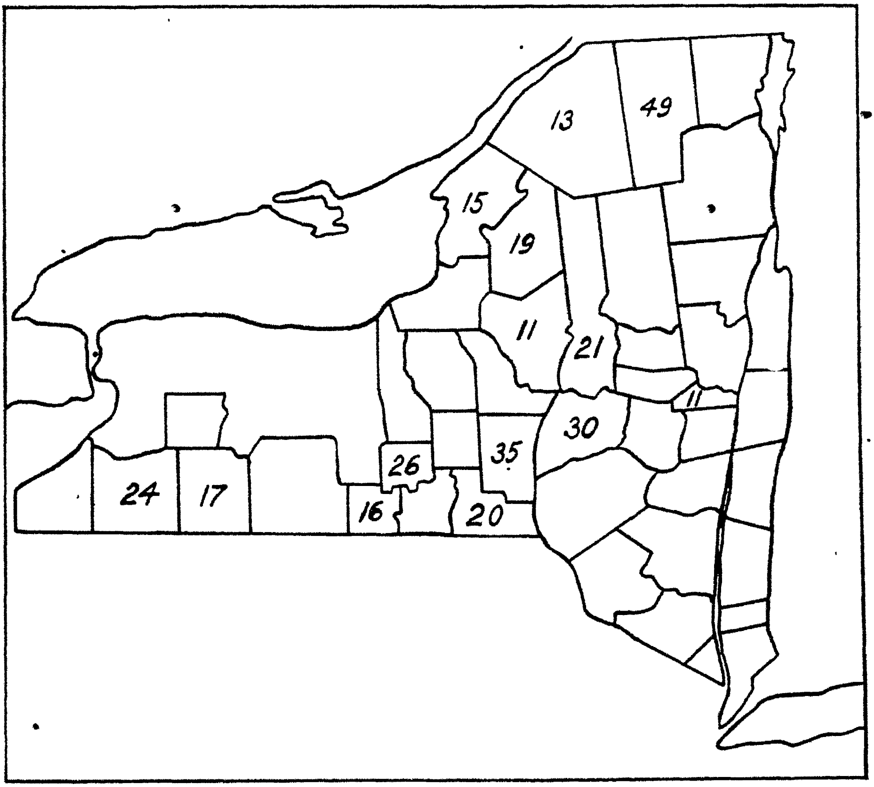

FIGURE 10. PER CENT OF MILK USED BY COUNTRY PLANTS FOR MAKING CONDENSED AND EVAPORATED MILK, 1923

(For counties using less than 10 per cent of their milk in this way, the figures are omitted)

Condenseries are a secondary source of market milk and cream. These plants assemble milk of good quality in large volume. Condensed milk and evaporated milk yield higher returns for raw milk than does butter or cheese

in western New York. More than 10 per cent of the milk is made into fancy cheese in Jefferson, Oneida, and Chenango Counties.

In 1923, about 8 per cent of the milk delivered to the country plants was used for making butter. Creamery butter-making is widely distributed, but is most important in the mountainous counties of eastern New York and in the western counties where dairying is a minor industry.

About 14 per cent of the milk handled by the country plants in New York is used for making condensed and evaporated milk, and powdered milk and cream. The importance of these products is greatest in a few northern, central, and western counties (figure 10). Because of the large investment required for a condensery, such plants are usually located in communities where large quantities of milk are produced. The powdered-milk business is frequently associated with the business of shipping cream, the skimmilk being disposed of in powdered form.

THE SUPPLY OF MARKET MILK

COMPARISON OF THE AVAILABLE SUPPLY WITH THE MARKET REQUIREMENTS

There are no complete statistics of the supply of milk available for shipment to the New York market from the milk-shipping area. However, by making use of such incomplete statistics as are available, it is possible to calculate the available supply of milk with reasonable accuracy. The results of such a calculation[11] are shown in figures 11 and 12.

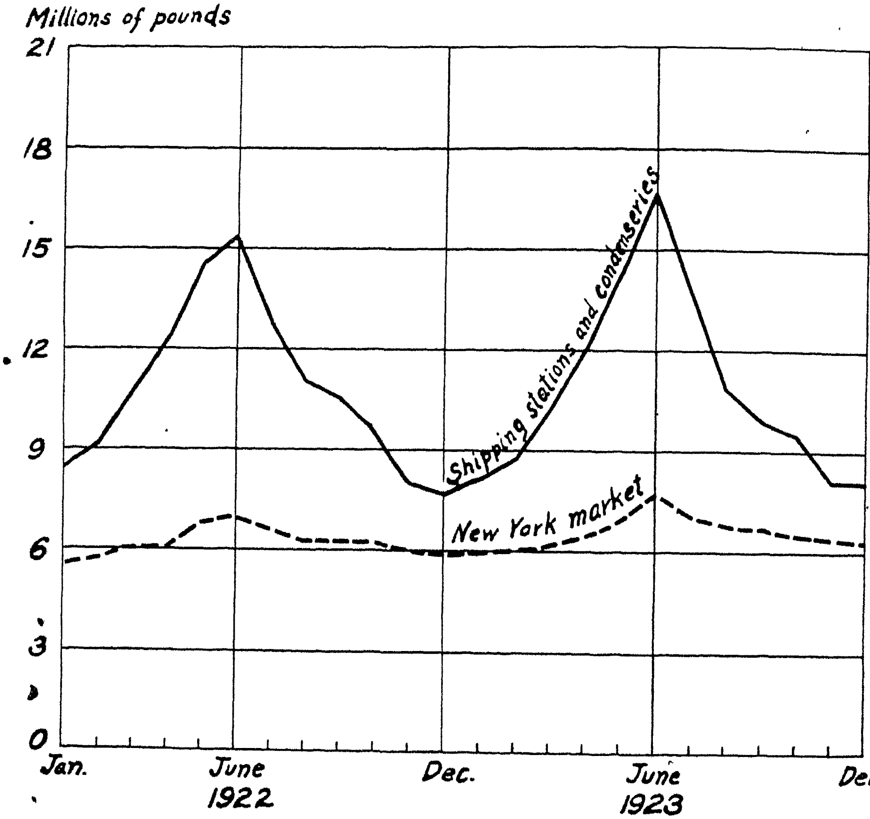

FIGURE 11. AVERAGE DAILY RECEIPTS OF MILK AT SHIPPING STATIONS AND CONDENSERIES AND AT THE NEW YORK MARKET, 1922–1923

The upper curve represents the supply of milk available for shipment to the New York market from the present milk-shipping area. The lower curve represents the demand for fluid milk in the New York market. The space between the two curves represents the quantity of surplus milk at the shipping stations and condenseries, which is separated for cream or used for manufacturing

In figure 11, the approximate average daily quantities of milk handled by country shipping stations and condenseries each month in 1922 and in 1923 are compared with the average daily receipts of fluid milk at the New York market. Practically all the milk distributed in fluid form in the New York market is supplied by these shipping stations and con-

[11] The methods of calculation are given in the appendix, tables 19 to 22, pages 45 and 46.

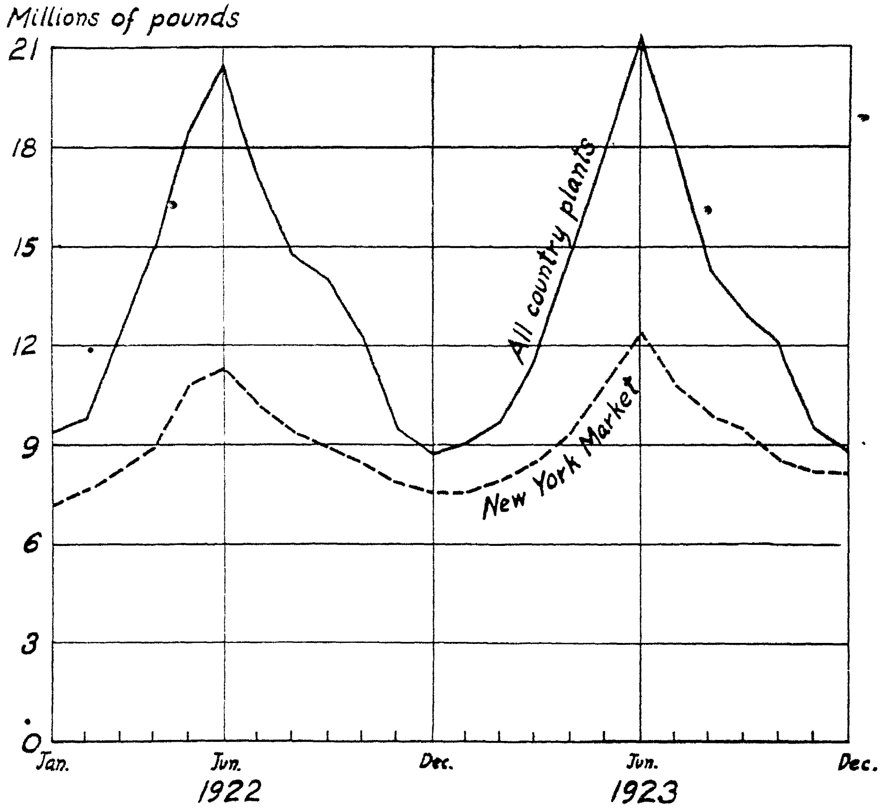

FIGURE 12. AVERAGE DAILY RECEIPTS OF MILK AND CREAM, IN TERMS OF THE WHOLE-MILK EQUIVALENT, AT ALL COUNTRY PLANTS IN THE MILK-SHIPPING AREA AND AT THE NEW YORK MARKET, 1922–1923

The upper curve represents the quantity of milk equivalent to the milk and cream delivered at all the country plants in the milk-shipping area, including shipping stations, condenseries, and butter and cheese factories. The lower curve represents the demand for fluid milk and cream (in terms of whole milk) in the New York market. The space between the two curves represents the quantity of milk and cream (in terms of whole milk) which is used for manufacturing

denseries. Large quantities of cream also are shipped from these plants. The remaining surplus is used for manufacturing.

In November, December, January, and February, the shipping stations and condenseries of this territory supply only slightly more milk than is required by the New York market. From March to October, there is a large surplus which must be separated and shipped as cream, or used for manufacturing. Considering the extra quantity of fluid milk necessary to allow for variations in production and consumption, the shipping stations and condenseries of this territory supply very little more milk in the short season than is required by the New York market.

In figure 12 the average daily quantity of milk handled by all country plants in the milk-shipping area each month in 1922 and in 1923 is compared with the receipts of both milk and cream (in terms of the whole-

milk equivalent) at the New York market. In addition to the supply handled by shipping stations and condenseries, the milk delivered to butter factories and to cheese factories is included also. The cheese plants now handle a much smaller proportion of the total supply than they did formerly. No doubt many more manufacturing plants will be replaced by fluid-milk-shipping stations as the market for fluid milk grows. However, a considerable number of manufacturing plants will survive indefinitely in the more distant parts of the milk-shipping area, and in other districts where milk is not produced in sufficient volume to justify the necessary expense in handling it or shipping it as market milk.

It is also worthy of note that the cheese and butter factories contribute very little milk in the winter months, when the shortage of fluid milk is most imminent.

GROWTH OF THE SHIPPING AREA

The growing needs of the New York market have been supplied by extending the milk-shipping area and by an increase in the quantity of milk produced per cow.

The first shipment of milk by rail to the New York market was made from Orange County, New York, in 1842.[12] The first regular milk train was run in 1847 from Otisville, in Orange County, to New York, a distance of 76 miles. The maximum distances from which milk was regularly hauled by the different lines in 1897, 1916, and 1925, are given in table 2:

TABLE 2. MAXIMUM DISTANCES FROM WHICH MILK WAS HAULED BY CERTAIN RAILROAD LINES TO THE NEW YORK MARKET, 1897, 1916, AND 1925

Year	Pennsylvania	Erie	Lehigh Valley	New York, Ontario & Western	West Shore	New York Central & Hudson River
	Miles					
1897	....	331	335	264	290	142
1916	503	448	401	325	339	469
1925	503	448	401	325	339	469

Regular milk-train service has been extended but little since 1916, but the long-haul milk traffic has increased markedly. The average length of haul is now slightly over 200 miles. In April, 1919, the base zone for price-making purposes was changed from the 150–160-mile freight zone to the 201–210-mile freight zone.

At present, very little milk is produced within 50 miles of New York and more than 98 per cent of the supply is shipped in by rail.

It is improbable that the milk-shipping area will be expanded as rapidly in the future as in the past. No adjacent surplus-milk regions of importance remain except in Canada. The present milk-shipping area is protected from importations, to some extent, by a restrictive tariff,[13] and

[12] Milk business of the Erie. The *Milk Reporter* (Sussex, New Jersey), June, 1907.
[13] The present duties are 2.5 cents per gallon of milk and 20 cents per gallon of cream.

the high freight rates on milk are likely to prevent the rapid expansion of the milk-shipping area into more distant regions.

In the future, Canada and the States west of New York will probably supply a large share of the cream required by the New York market. During the year 1923, about 124,000 forty-quart cans of cream were imported into New York State from Canada, largely for the New York City market.[14] In the twelve months ending with April, 1925, 171,600 forty-quart cans of cream were shipped from seven middle-western States to this market.[15] In November and December, 1924, and in January and February, 1925, from 29 to 39 per cent of the New York cream receipts were supplied by these seven States.

The freight rate on cream in carloads, from Reedsburg, Wisconsin, to Jersey City, New Jersey, is $1.74 per forty-quart can, or less than 10 per cent of the wholesale value at the destination. The cost of shipping cream in carloads from Brownsville, Ontario, to Jersey City, New Jersey, is $1.12 for freight plus $2.00 for import duty, or $3.12, per forty-quart can.

TREND OF MILK PRODUCTION

The number of dairy cows in the shipping area is now slightly less than the number kept in the same counties twenty years ago. The average quantity of milk produced per cow, however, has increased about 25 per cent. In 1900 the quantity of milk sold or manufactured into butter or cheese on New York farms amounted to 3840 pounds per cow.[16] In 1922 the average quantity of milk delivered per cow at the country plants in New York State was 4824 pounds.[17]

VARIATIONS IN THE PRODUCTION OF MILK

Variation from year to year

The quantity of milk produced varies from year to year, depending primarily on the relative prices received by the dairymen for milk, and on the weather conditions. The average quantities of milk delivered daily per dairy for each year since 1910 at thirty representative fluid-milk plants in New York State are shown in table 3.

The changes in production per dairy were similar in each region, with only minor differences. On the average, production declined from 273 pounds per dairy, daily, in 1911, to 214 pounds in 1918, a decrease of 22 per cent. By 1924 the daily average was 258 pounds, an increase of 21 per cent over 1918. In general, the rate of production was greater in 1924 than for many years.

The drastic decrease in production from 1911 to 1916 was coincident with a decreasing purchasing power of milk. The general level of prices was rising during this period, while the price of milk remained practically stationary. In September, 1916, the price of milk, relative to the general price level, was lower than at any other time in fifteen years, and was

[14] New York State Dept. Farms and Markets. Agr. bul. 170, 1924, p. 63
[15] Detailed figures are given in the appendix, table 23, page 47.
[16] New York State Dept. Farms and Markets. Circular 186, May, 1920.
[17] New York State Dept. Farms and Markets. Agr. bul. 158, 1923, p. 19.

TABLE 3. DAILY AVERAGE QUANTITY OF MILK DELIVERED PER DAIRY AT 30 SHIPPING STATIONS IN NEW YORK STATE*

Group †	1	2	3	4	5	6	
Counties	Columbia and Dutchess	Orange and Sullivan	Delaware and Otsego	Broome and Chenango	Tioga and Tompkins	Clinton, St. Lawrence, Washington, and Oneida	Average for the six groups
Number of plants	7	7	3	4	4	5	30
Year	Pounds of milk delivered						
1910......	242	353	249	265	190	250	262
1911......	247	352	253	276	203	275	273
1912......	217	327	238	254	188	270	255
1913......	207	336	232	241	183	260	247
1914......	199	331	235	243	179	249	241
1915......	202	314	230	243	168	243	234
1916......	202	290	214	226	154	243	222
1917......	192	293	206	233	165	239	220
1918......	182	301	209	222	164	218	214
1919......	193	304	229	247	171	221	224
1920......	196	306	266	256	173	221	233
1921......	220	330	287	260	186	230	252
1922......	242	324	283	246	184	229	251
1923......	248	321	270	245	183	240	254
1924......	250	306	278	264	186	236	258

* Index numbers of the monthly deliveries per dairy are given in the appendix, table 24, p. 47.
† The six groups of plants are arranged in the order of their distance from New York.

20 per cent less than the average during the pre-war period, 1910 to 1914. In October the milk producers struck and the price was raised. From 1917 to 1920 the price of milk was relatively high, but, except in the Orange-Sullivan County district, production did not begin to increase until one or two years after the price was raised.

Monthly variations

Monthly variations in production are illustrated in figure 13.[18] It is noticeable that the variations are much more violent since 1916 than they were previously. Milk distributors must allow for these variations in the supply of milk by buying considerably more milk than is actually required for their milk and cream trade. If the production of milk per dairy could be forecast with reasonable accuracy, prices could be determined more intelligently and some economies in distribution might result.

Changes in seasonal variation

There is a general trend toward more winter dairying, particularly in the counties that have more recently been brought into the milk-shipping

[18] The index numbers are given in the appendix, table 24, page 47.

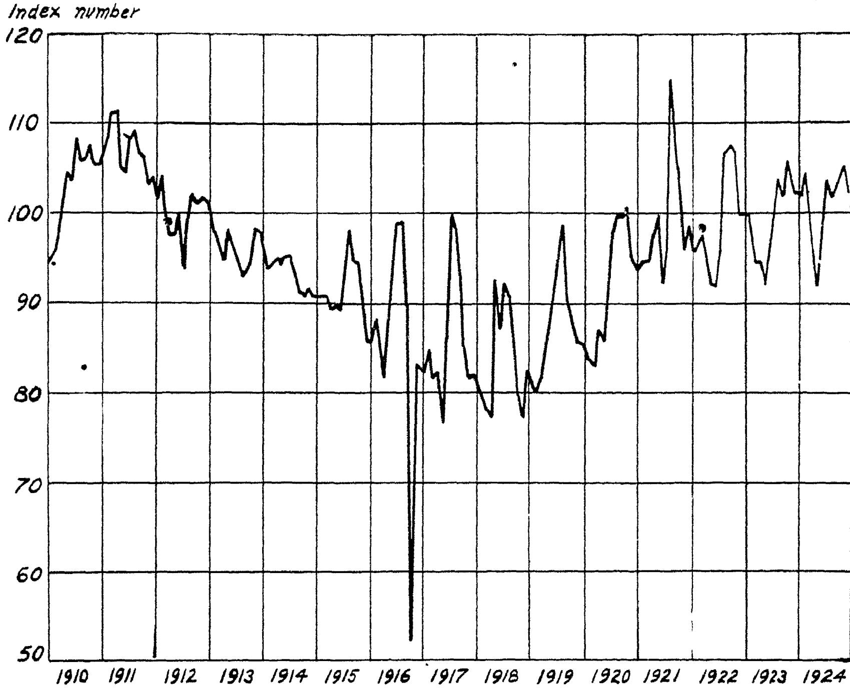

FIGURE 13. INDEX NUMBERS OF THE QUANTITIES OF MILK DELIVERED MONTHLY PER DAIRY AT 30 SHIPPING STATIONS IN NEW YORK

(Average quantities for the corresponding months in the five-years period from 1910 to 1914 = 100)

Milk production is more variable than the demand for milk. The variations in production are caused chiefly by changes in prices and in weather conditions

zone. There are also important variations from this general trend, lasting for several years. Some changes in the seasonal distribution of production are shown in table 4 and in figure 14.

In the oldest market-milk counties (groups 1 and 2), a larger proportion of the milk is being produced in the summer months. This change is apparently due to more supplementary feeding during July, August, September, and October. In groups 3 and 4, a considerable increase in winter dairying is evident. In group 5, a mixed dairy and crop-farming region, the change is very slight, summer production apparently being stimulated somewhat by more supplementary feeding. In group 6, a much larger proportion of the milk is now produced in July, August, September, and October, but there seems to be little or no change in the time at which the cows freshen.

The increased production of milk during August, September, and October is the most outstanding change (figure 14). This change is accounted for in part by the relatively higher prices paid for milk at this season (figure 15). Taking the territory as a whole, production has been relatively greater in August, September, and October in recent years, altho the

TABLE 4. SEASONAL VARIATION IN THE QUANTITY OF MILK DELIVERED PER DAIRY AT 30 SHIPPING STATIONS

(Average quantity delivered per dairy daily during each five-years period = 100)

Group	1		2		3		4		5		6		Average for the six groups	
Counties	Columbia and Dutchess		Orange and Sullivan		Delaware and Otsego		Broome and Chenango		Tioga and Tompkins		Clinton, St. Lawrence, Washington, and Oneida			
Number of plants	7		7		3		4		4		5		30	
Period	1910–14	1920–24	1910–14	1920–24	1910–14	1920–24	1910–14	1920–24	1910–14	1920–24	1910–14	1920–24	1910–14	1920–24
January	115.5	112.3	112.6	111.1	77.1	84.0	73.0	82.5	101.0	103.6	79.2	73.8	97.2	97.4
February	118.6	112.9	116.3	113.3	87.5	94.4	80.7	89.6	106.5	108.8	88.6	81.8	103.0	102.2
March	118.6	113.5	118.1	113.5	108.2	110.8	97.6	101.9	114.4	114.0	108.9	101.6	111.9	109.4
April	114.9	113.0	118.7	111.6	127.2	125.1	116.5	115.3	120.5	119.1	123.2	121.4	119.0	116.2
May	120.5	116.2	119.4	115.0	151.4	139.8	147.6	134.6	132.4	130.7	143.8	136.3	132.2	126.1
June	113.9	110.9	108.2	107.9	153.1	142.0	157.9	146.4	132.2	131.5	150.2	147.9	130.4	127.0
July	75.9	79.8	76.5	80.7	119.0	111.0	124.0	115.7	96.7	97.0	113.7	120.7	96.1	97.2
August	62.8	68.9	67.2	74.2	89.1	87.6	95.1	97.6	71.3	75.4	89.5	102.9	77.1	82.8
September	72.2	80.9	76.6	82.9	79.7	81.4	88.4	86.9	68.6	69.3	86.1	94.8	78.9	83.2
October	84.3	92.5	87.5	92.6	75.5	81.8	83.4	83.4	78.1	78.0	80.2	85.9	82.9	87.6
November	94.4	95.0	94.6	94.4	63.8	69.0	67.8	70.9	84.3	80.6	66.6	66.0	81.7	82.2
December	108.3	104.3	104.3	102.8	68.6	72.8	68.1	75.1	94.1	92.1	70.2	66.6	89.4	89.0

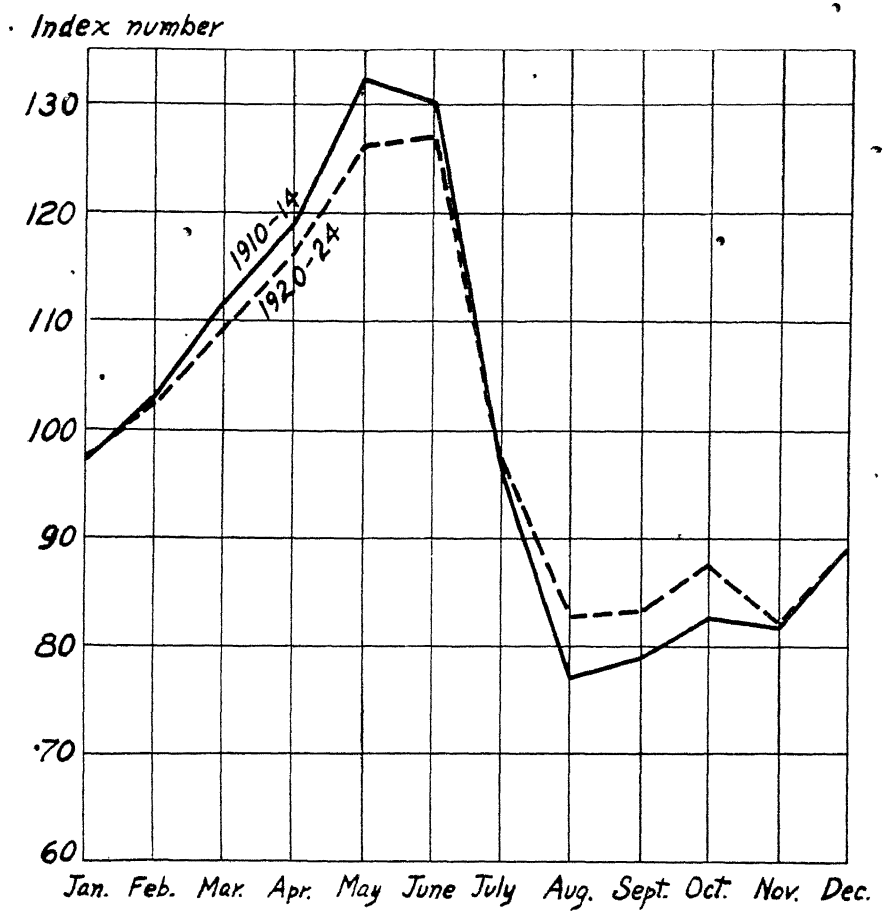

FIGURE 14. SEASONAL VARIATION IN THE QUANTITY OF MILK DELIVERED PER DAIRY AT 30 SHIPPING STATIONS, 1910–1914 AND 1920–1924
(Average quantity delivered daily during each five-years period = 100)
In the later period, production was relatively greater in the late summer, and relatively less in the spring, than it was in the earlier period

greatest relative increase in price is for the months of May, June, and July. The price is not known to the farmers until about the twentieth of the month following the month in which the milk is delivered.

UTILIZATION OF THE MILK

Accurate information relative to the utilization of milk is not available for the counties outside of New York State which are tributary to the New York City market. However, since more than 80 per cent of the total supply is included in the New York counties, the figures for these counties apply with reasonable accuracy to the whole shipping area.

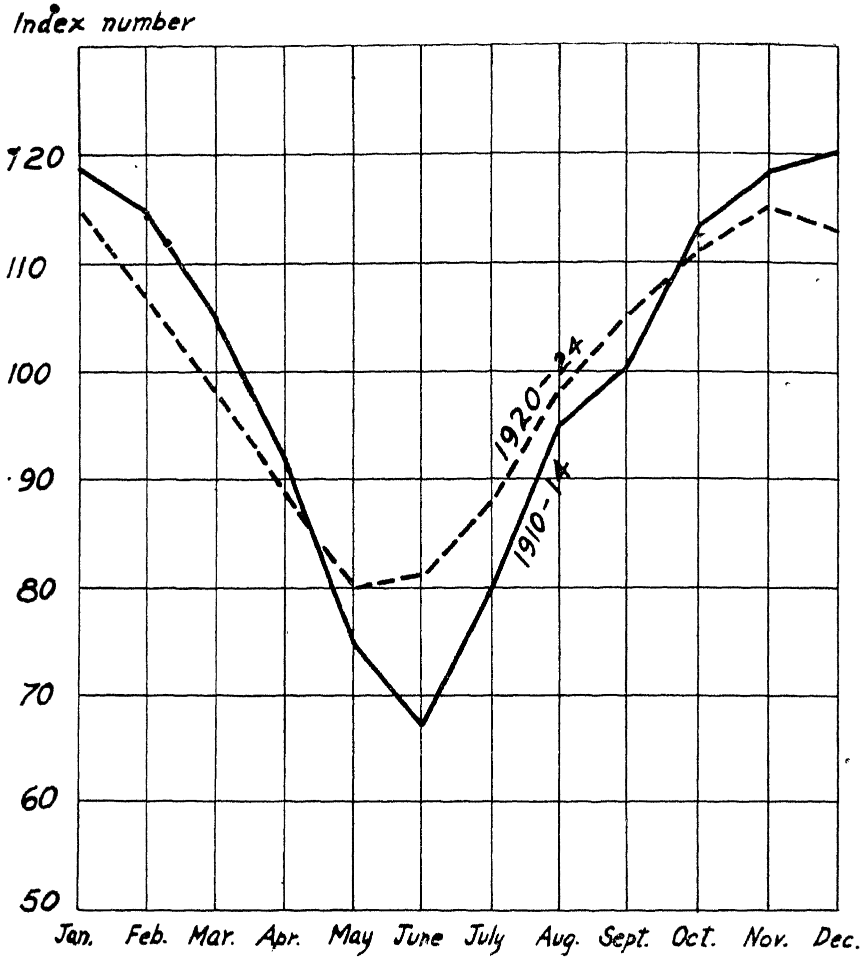

FIGURE 15. SEASONAL VARIATION IN PRICES PAID TO PRODUCERS OF MARKET MILK IN THE NEW YORK TERRITORY, 1910–1914 AND 1920–1924

(Average price for each five-years period = 100)

In the later period, the price was relatively higher in summer, and relatively lower in winter, than it was in the earlier period

Utilization at the various types of milk plants

There are five distinct types of plants that receive milk directly from farmers. The percentage of the total supply handled by the plants of each type, and the percentage of the milk used by these plants in various ways, are shown in table 5.

In 1922 and 1923, fluid-milk-shipping stations handled 56 per cent of all the milk delivered by farmers to the milk plants in these counties. Of the milk handled by these plants, 69 per cent was shipped as fluid milk and 22 per cent was shipped as cream, only 9 per cent being used for manufacturing.

TABLE 5. UTILIZATION OF MILK AT VARIOUS TYPES OF COUNTRY MILK PLANTS IN NEW YORK COUNTIES TRIBUTARY TO THE NEW YORK MARKET, 1922–1923*

Kind of plant	Per cent of total supply handled	Per cent of milk used for each product						
		Milk	Cream	Condensed, evaporated, and powdered milk	Cheese	Butter	Other uses	Total
Shipping stations	56	69	22	1	4	4	....	100
Condenseries	18	6	27	62	2	3	.....	100
Cheese and butter factories	17	3	4	...	70	23	......	100
Ice-cream and candy factories	2	..	27	10	4	16	43	100
Average	93	43	20	13	15	8	1	100
Local plants	7	73	16	1	1	6	3	100

* Computed from reports made to the New York State Department of Farms and Markets by plants receiving milk or cream from farmers.

Condenseries handled 18 per cent of the milk, but only 62 per cent of the milk received at these plants was condensed or evaporated; 27 per cent was shipped as cream, and 6 per cent was shipped as fluid milk. This indicates the extent to which the condenseries supplement the shipping stations in supplying the cities with milk and cream.

Cheese and butter factories handled 17 per cent of the milk. The principal products were cheese and butter, but some milk and cream were sold in up-state cities.

Relatively few ice-cream or candy factories receive milk or cream directly from farmers, only 2 per cent of the supply being delivered to plants of this type. Of the milk received at these plants, 43 per cent was used for making ice cream, ice-cream stock, and candy; 27 per cent was shipped as cream, and 30 per cent was used for butter, condensed milk, and cheese. Most of the cream probably went to other ice-cream plants in the cities of the metropolitan district.

Of the total supply of milk handled by these four types of country plants in the New York shipping area, 43 per cent was shipped as fluid milk, 20 per cent was shipped as cream, and 37 per cent was used in the manufacturing of milk products.

" Local plants " include the plants supplying up-state cities or shipping to cities outside the New York market. These plants handled 7 per cent of the total supply, and sold as fluid milk or cream 89 per cent of the milk received. Most of the remainder was made into butter and ice cream.

Net return from different uses of milk

The class prices quoted by the Dairymen's League Cooperative Association, Inc., afford a basis for comparing the returns from the different uses of milk in this territory during the past four years. The average class prices are given in table 6.

The prices quoted for Class 1 and Class 2 were not maintained in all cases, the average price at which these two classes were actually sold having been slightly less than the quotations. The difference between the Class-1 price and other class prices is greater in the less distant, and

TABLE 6. AVERAGE CLASS PRICES QUOTED BY THE DAIRYMEN'S LEAGUE COOPERATIVE ASSOCIATION, INC., FOR 3-PER-CENT MILK IN THE 201–210-MILE FREIGHT ZONE*

Year ending with April	Class 1, fluid milk	Class 2, cream	Class 3, condensed and evaporated milk	Class 4a, butter	Class 4b, cheese
1922	$2 72	$1.94	$1.57	$1.21	$1 23
1923	2.68	2.14	1.84	1.39	1 60
1924	2.62	2.23	2.08	1.61	1 57
1925	2 60	2.01	1 68	1.36	1 45
Average	$2.66	$2.08	$1.79	$1.39	$1 45
Amount under Class 1	....	0.58	0.87	1 27	1 21

* Monthly prices are given in the appendix, table 25, page 48.

less in the more distant, freight zones, since the freight differential for Class 1 is higher than that for the other classes.

The differences in the net return from the different uses of milk are accounted for chiefly by differences in conditions affecting the supply of milk available for each use. Fluid milk, because it is bulky and perishable, cannot be supplied economically by regions far from the market. Production in the milk-shipping area is also limited by the costs involved in meeting the higher sanitary requirements for market milk.

Cream has less bulk per unit of value and can be more economically shipped long distances; hence a relatively larger supply is available for the market. Condensed and evaporated milk are more bulky than cream, but are less perishable; these products are supplied largely by the surplus milk regions far from market. Butter and cheese have small bulk per unit of value, are relatively nonperishable, and can be economically shipped long distances. Condensed and evaporated milk, and butter and cheese, can be stored for several months without serious deterioration, and are manufactured mainly at the season when milk is cheapest. Large fixed charges are involved in operating condenseries and fluid-milk-shipping stations; consequently such plants are usually located only in the more intensive dairy regions. Butter factories, however, can assemble cream economically from the less intensive dairy regions. Hence a larger supply of milk is available for making butter than for market milk and cream, or for condensed and evaporated milk. However, altho condensed and evaporated milk, and butter and cheese, yield lower average returns than do market milk and cream, these products are likely to be manufactured in considerable quantity in the New York market-milk region indefinitely: first, because the season of milk production is not adjusted to the seasonal demand for fluid milk and cream; secondly, because other variations in production and consumption make necessary a certain amount of surplus as a "margin of safety"; and thirdly, because in many communities the shipping facilities are unsatisfactory, or the volume of milk is so small that it cannot be economically shipped as market milk or cream.

Utilization of skimmilk

Since a large proportion of the milk delivered to the country plants is separated and shipped as cream or is used for making butter, large quantities of skimmilk remain to be disposed of. Some of this is shipped for fluid use either as plain skimmilk or cultured (artificial) buttermilk; some is used for cottage cheese, other skimmilk cheeses, condensed skimmilk, dried skimmilk, dried casein, milk sugar, milk albumen, and other by-products; and some is resold to farmers. A large proportion of the skimmilk, however, is wasted. It is an open question whether it would not be wise for many farmers to separate the milk on the farm and deliver only the cream to the plants. By this method, some saving would be made in hauling costs and the skimmilk would be available for poultry, calves, or pigs. It is often worth more on the farms than at the plants.

THE PROCESS OF MARKETING FLUID MILK

FUNCTIONS OF COUNTRY PLANTS

In marketing fluid milk, the milk is first assembled from the farms at country plants. The typical country milk-plant is a wooden structure, with an ice house attached, and is located along a railroad siding. A country plant commonly handles the milk produced by from 50 to 150 farmers. Previous to 1921, most of the country milk stations were owned and operated by the milk distributors. At present a large number are owned and operated by farmers' cooperative associations.

The milk is weighed as it is delivered at the plants, and at frequent intervals samples are taken to determine the percentage of butterfat. Where the bacteria count is the basis for payment of premiums for high-quality milk, samples are taken for this purpose also. Milk not properly cooled or milk that is off in odor is usually rejected. At some plants, samples of milk are filtered in order to determine the amount of dirt present.

The usual style of container, both for delivering to the country plant and for shipment to the city, is the forty-quart can. Cans used for delivering milk to the plants are usually owned by the producers; those used for shipment are usually owned by the milk company.

The processes which are carried on at the country plants vary. The minimum procedure is to receive, weigh, sample, and cool the milk, and put it up in full forty-quart cans. The milk from many producers is usually mingled in a large tank. This tends to standardize the milk in respect to butterfat and other qualities. The farmers' cans are emptied, washed, and returned to them in the course of a few minutes.

Some country plants are equipped for pasteurizing; relatively few are equipped for bottling. More than half the bottling and a large share of the pasteurizing are done in the city plants. The deciding factors are time and cost. In many instances, particularly at the more distant stations, there is insufficient time to pasteurize, or to pasteurize and bottle, the milk before the milk train leaves. Neither of these operations can be performed economically unless a large volume of milk is available. Few plants that handle less than 10,000 pounds of milk a day, or plants that are located where the milk train leaves before 11.30 a. m., do any

pasteurizing or bottling. Freight costs are higher on bottled milk. The less-than-carlot freight rate from the 201–210-mile zone is 1.1 cents per quart when milk is shipped in forty-quart cans, and 1.6 cents per quart when it is shipped in quart bottles.

Since the daily deliveries of milk at the plants do not conform to the city requirements for fluid milk, there are varying amounts of surplus milk which are kept in the country in order to avoid payment of freight charges on milk not required for the fluid-milk trade. Companies that operate many country plants usually ship all the milk from some plants at all times, and draw upon other plants when more milk is needed. These plants are equipped for manufacturing. In some instances, surplus milk from a number of shipping stations is assembled at a condensery, but many shipping stations are equipped to make butter or cheese.

TRANSPORTATION

Milk is delivered to the New York market by ten different railroads. The relative importance of these carriers is shown in table 7:

TABLE 7. PERCENTAGE OF MILK AND CREAM DELIVERED TO THE NEW YORK MARKET OVER EACH RAILROAD*

Railroad	Milk		Cream	
	1914	1924	1914	1924
	Per cent			
New York Central & Hudson River	24.1	32.7	23.8	20.0
Delaware, Lackawanna & Western	16.4	15.3	8.9	4.9
Erie	13.0	13.2	21.4	15.8
Lehigh Valley	11.0	9.8	6.7	5.2
New York, Ontario & Western	14.4	9.6	17.2	11.0
Pennsylvania	1.3	6.2	3.0	30.5
Harlem	7.9	5.1	10.1	0.9
West Shore	4.3	3.7	5.6	10.9
New York, Susquehanna & Western	3.3	3.0	2.7	0.8
New York, New Haven & Hartford	2.1	0.1	0.4	0.0
Other sources	2.2	1.3	0.2	0.0
	100.0	100.0	100.0	100.0

* Computed from data published in the *Milk Reporter*.

The New York Central Railroad carries about one-third of the milk and one-fifth of the cream shipped to the New York market. It serves the intensive dairy region of east-central and northern New York. The importance of these regions as sources of market milk and cream has been increasing rapidly during the past ten years. Milk traffic originating on the Delaware & Hudson and on the Rutland is delivered to New York over the New York Central.

Milk and cream traffic has been increasing rapidly on the Pennsylvania Railroad. In 1914 the Pennsylvania delivered only 3 per cent of the cream received at the New York market. In 1924, 30 per cent of

the cream was delivered by this road. A large proportion of this is long-haul traffic, originating in States west of New York and Pennsylvania.

High-class transportation service is required for milk. Special trains of milk cars are operated on fast schedules. For example, a milk train leaves Hornell, on the Erie Railroad (322 miles from New York), at 11.45 a. m. It runs as a local train, picking up loaded cars and less-than-carload lots of milk at the various stations along the Erie as far east as Susquehanna, Pennsylvania (193 miles from New York), where it is scheduled to arrive at 5.15 p. m. It picks up milk also from branch lines at Corning and Elmira. From Susquehanna this train is run to Jersey City as a thru train. Its schedule calls for arrival at Jersey City at 11.45 p. m. The running time from Hornell to Susquehanna is 5 hours and 30 minutes, as compared with 3 hours and 27 minutes for the fastest passenger train (train 1000) on this road. The running time from Susquehanna to Jersey City is 6 hours and 40 minutes, as compared with 5 hours for the passenger train. Similar service is provided by the other carriers.

The railroads maintain special milk platforms at the metropolitan terminals, and a force of men to unload cars and reload empty cans. The terminals maintained at present are as follows:

New York Central — West 29th Street, Manhattan, New York
West 130th Street, Manhattan, New York
Melrose Junction, The Bronx, New York
New York, New Haven & Hartford — Harlem River, The Bronx, New York
Erie — Jersey City, New Jersey
Lehigh Valley — Jersey City, New Jersey
Pennsylvania — Jersey City, New Jersey
Flatbush Avenue, Brooklyn, New York
Delaware, Lackawanna & Western — Hoboken, New Jersey
West Shore — Weehawken, New Jersey
New York, Ontario & Western — Weehawken, New Jersey

Milk freight rates, unlike most other freight rates to New York, do not include lighterage (transportation on lighters to various parts of the harbor). The uniform interstate scale of rates applies to deliveries at all metropolitan terminals except the Flatbush Avenue terminal of the Pennsylvania Railroad in Brooklyn. The rate to this point is 9.5 cents per forty-quart can higher than the rate to the New Jersey terminals.

In the metropolitan district the milk plants are not located on railroad sidings. Consequently the milk must be trucked from the railroad platforms to the plants. Only the Pennsylvania Railroad is able to deliver milk direct to Brooklyn, and no milk is delivered to Queens by rail. Most of the milk and cream required for these boroughs must be trucked from the west side of Manhattan or from the New Jersey terminals. The New York Central does not deliver enough milk in Manhattan to supply that borough. On the other hand, much more milk is delivered at the New Jersey platforms than is needed on the Jersey side. Milk is trucked from Weehawken, Hoboken, and Jersey City to all parts of the metropolitan district. This trucking involves a large expense, much of which could probably be eliminated by a pooling of terminal facilities by the different railroads so as to effect more direct delivery of the milk.

The mileage basis of rate making was adopted by the Interstate Commerce Commission in 1917. In its report[19] the commission cited the following:

We find that the present zone adjustment and charges maintained by the Pennsylvania on shipments of milk and cream to Philadelphia and other points are unreasonable and unduly prejudicial to producers and shippers from near-by points, and unduly prefer producers and shippers from distant points.

The comparative rates for three periods, applicable to the zones existing before June 21, 1917, are given in table 8:

TABLE 8. FREIGHT RATES ON MILK TO NEW YORK

Miles	Cents per forty-quart can				
	Prior to February 23, 1915	From February 23, 1915, to September 30, 1917	From October 1, 1917, to June 24, 1918	From June 25, 1918, to August 25, 1920	Since August 25, 1920
1– 40......	23.0	24.2	15.5–18 5	19 4–23 1	23 5–27 5
41–100......	26 0	27.3	19.4–23 4	24 3–29 3	29 5–35 5
101–190......	29 0	30.5	24 1–29 2	30.1–36 5	36.0–44 0
191–400......	32.0	33.6	29 8–39.6	37.3–49 5	45.0–59 5
401–600......	32.0	33 6	40 1–47 5	50 1–59 4	60 0–71.5

The change in rates effective October 1, 1917, lowered the rate from all points less than 270 miles and raised the rate from all points more than 270 miles from New York. All subsequent changes in rates have been percentage increases. Consequently the differentials between rates from near-by and from more distant points have also increased. The increases in rates on the long-haul milk have not prevented the growth of the traffic altho they have resulted in greater differences in prices paid for milk in the different zones.

These basic rates are for less-than-carload (l.c.l.) shipments, the cars being loaded and iced by the railroad. The minimum carload is 225 forty-quart cans, or 625 twelve-quart cases of bottles. Carload rates are 87.5 per cent of the l.c.l. rates, cars being loaded and iced by the shippers.

There are some exceptions to these schedules. For example, the Ulster & Delaware Railroad is permitted to charge 15 per cent more than the given scale of rates from all points more than 130 miles from New York. This allowance is made because the Ulster & Delaware operates in a mountainous section of country. The Delaware & Hudson Railroad, under an intra-state tariff, charges a flat rate on all shipments from points on its division south of Albany. The present rate is 50.5 cents per forty-quart can, or the equivalent of the interstate rate in the 261–270-mile zone.

A railroad is permitted to lower rates from competitive points to the rate applicable to the carrier having the shortest haul. Railroads do not always take advantage of this privilege, however. For example, Cortland, New York, is 249 miles from New York by way of the Delaware, Lacka-

[19] Interstate Commerce Commission Reports, vol. 45, p. 386.

wanna & Western Railroad, and 341 miles from New York by way of the Lehigh Valley. By way of the Delaware, Lackawanna & Western the rate per forty-quart can is 48.5 cents, and by way of the Lehigh Valley the rate is 56.5 cents. The Lehigh Valley would be permitted to lower its rate to the Delaware, Lackawanna & Western rate if it desired to do so.

From Owego, New York, milk may be shipped to the New York market over three railroad lines: the Lehigh Valley, the Erie, and the Delaware, Lackawanna & Western. The rate by way of the Lehigh Valley is about 5 cents per can more than by way of either of the other roads. Considering only the freight rates on fluid milk, patrons at a plant located on the Erie or on the Delaware, Lackawanna & Western, should receive about 5 cents per can more than do patrons delivering to a plant on the Lehigh Valley. When a farmer feeds one pound of grain to each four pounds of milk produced, a difference of 5 cents per can in the price received for milk is equivalent to a difference of $4.70 per ton in the price paid for feed. However, there are no differences in feed prices according to the railroad over which the feed is shipped.

So far as milk distributed in fluid form is concerned, the delivered cost to the dealer is about the same, irrespective of the freight zone in which it is bought, since the price paid at the country plant varies inversely as the freight (l.c.l.) on fluid milk. The milk bought in the more distant zones may be slightly cheaper, provided shipments can be made in car lots. Milk to be used for making cream or other concentrated products is cheaper when bought in the more distant zones, because the cost of shipping the product to market is less than the freight differential on the milk bought.

CITY DISTRIBUTION

There are three common channels thru which milk reaches the consumer in the metropolitan district: (1) in bottles from route wagons of the retail distributors; (2) in bottles or in bulk from retail food stores; and (3) at hotels, restaurants, and the like.

There are no complete statistics as to the relative importance of these three methods of distribution. It is estimated that from 60 to 65 per cent of the total is for household consumption, the remaining 35 to 40 per cent being distributed thru hotels, restaurants, steamship lines, and the like. About half of the household consumption is distributed in bottles on the retail wagons, and about half is distributed thru the stores. The major part of the store milk is sold in bulk. In other words, about one-third of the total quantity received at the metropolitan terminals is delivered on retail wagons; about one-third is distributed by the stores, mostly in bulk; and about one-third is distributed thru restaurants, hotels, and the like, nearly all in bulk.

A very large part of the retail trade is in the hands of the two largest distributors—the Borden's Farm Products Co., Inc., and the Sheffield Farms Co., Inc. The remainder of the business is divided among a number of smaller distributors. Costs are high for this type of distribution, since a high class of service is rendered.

Since May, 1921, a large part of the milk distributed in the metropolitan district has been sold to the dealers at prices varying according to the use to which it is put. For this period, it is possible to make comparisons

between the dealers' buying and selling prices for fluid milk. Such comparisons, together with the cost of freight from the 200–210-mile zone and the amount of the dealers' margin, are shown in table 9:[20]

TABLE 9. COMPONENT PARTS OF PRICE PAID BY CONSUMERS FOR GRADE B BOTTLED MILK, DISTRIBUTED ON RETAIL WAGONS IN NEW YORK CITY

Year ending with April	Cents per quart			
	Price at country plant*	Freight (l.c.l.)	Dealers' margin	Retail price
1922	6.3	1.1	7.3	14.7
1923	6.3	1.1	7.3	14.7
1924	6.0	1.1	7.3	14.4
1925	6.0	1.1	7.4	14.5

* Dairymen's League Class-1 prices for 3.5-per-cent milk, 201–210-mile zone.

For these four years, the dealers' gross margin on retail sales of bottled milk averaged 7.3 cents a quart, or about 50 per cent of the retail price. Only part of the milk purchased at the Class-1 price was sold at the retail price. The average real margin on all sales of fluid milk was probably less than 6 cents a quart. This margin covers the cost of operating country plants, the costs of trucking the milk from railway terminals to city plants, the costs of operating city plants (including pasteurizing and bottling), the costs of delivery, and the administrative and miscellaneous expenses.

The business of distributing milk lends itself particularly well to large-scale organization. The fixed expenses are so high that the unit costs are much less when the volume of business is large. These economies extend to the operation of plants, to the delivery system, and to the marketing of by-products.

The wholesale trade in milk is divided among a large number of firms. Retail stores, restaurants, and hotels are the principal customers. Most of the chain and unit grocery stores sell milk, as do the numerous delicatessen shops, bakeries, and dairy stores. The Sheffield Farms Co., Inc., one of the large retail distributors, operates a chain of grocery stores which sell milk. Most of the stores sell both bottled and bulk milk. The bottled milk ordinarily sells at the same price as that from retail wagons, while the milk in bulk sells at from 4 to 5 cents a quart less. In New York City the Department of Health permits the sale of bulk milk in stores but not on wagons. The milk is delivered to the stores in forty-quart cans, and is carried home by the consumers in their own containers. This is a relatively cheap method of distribution, since there is no expense for bottling and the consumers perform part of the work of delivery. Bulk milk has a very large sale in certain sections of the city, particularly in the congested tenement districts. In supplying the stores in these sections, the problem of credit is important. It is largely because of this fact that the small dealers have been able to maintain their position in the wholesale trade. The chain stores usually buy from one of the larger companies which can furnish them with milk in all parts of the city.

[20] The monthly prices are given in the appendix, table 26, page 50.

The large volume of wholesale distribution in New York makes it comparatively easy for new plants or distributors to find an outlet for their milk. The retail-route trade is based on the long-established good will of the milk company. The wholesale trade is more competitive.

Some of the dealers operating in this wholesale trade do not have country plants, but buy their milk from independent country plants or from other dealers. A number of independent farmer-owned plants sell to wholesale dealers.

SANITARY CONTROL

Milk is bought for city distribution under the rules of the department of health of the municipality in which the milk is sold. New York City maintains an effective system of sanitary control. Certain minimum requirements are specified, both for the farms on which the milk is produced and for the plants thru which it is handled. A force of inspectors is maintained by the Department of Health to inspect the plants and the dairies. The milk companies also employ men to inspect the dairies. In practice, if conditions either on the farms or in the plants do not meet the sanitary requirements, the milk is excluded until conditions are corrected. The inspection system tends to limit the supply of milk and to encourage consumption by improving the quality.

The three principal grades of milk established by the New York City Department of Health are: Grade A raw, Grade A pasteurized, and Grade B pasteurized. The relative importance of each grade of milk is shown in table 10:

TABLE 10. VOLUME AND PERCENTAGE OF EACH GRADE OF MILK DISTRIBUTED IN NEW YORK CITY*

Grade	Quarts distributed daily, approximate		Percentage of total distribution	
	October, 1922	May, 1925	October, 1922	May, 1925
A raw	50,000	60,000	2 1	2.2
A pasteurized	250,000	400,000	10.6	14.5
B pasteurized	2,050,000	2,290,000	87.3	83.3

* Data furnished by the New York City Department of Health.

In recent years Grade A pasteurized milk has increased in favor rapidly. The retail price is 3 cents a quart higher than for Grade B. Grade A milk is distributed principally by the largest companies, and is purchased chiefly for children.

There is a real difference between Grade A and Grade B pasteurized milk with respect to the precautions against excessive contamination and against excessive growth of bacteria in the milk. The farms where Grade A milk is produced and the plants where Grade A milk is handled are subject to sanitary requirements which are somewhat more strict than the requirements for Grade B milk. All cows from which milk is delivered to Grade A plants are tuberculin-tested, and premiums are paid for milk showing low bacteria counts. The milk must be kept at lower temperatures than are required for Grade B milk, and in other ways more care is exercised in the handling and the distribution of the milk.

What has been said regarding the grades of milk applies to New York City only. Each municipality has a different set of regulations covering the production, the handling, and the distribution of milk. Generally speaking, the sanitary requirements imposed by New York City are more strict than those imposed by most other municipalities included in the New York market. The difference in requirements gives rise to considerable difficulty in enforcement, and also creates dissatisfaction among the dairymen.

COOPERATIVE ORGANIZATIONS

Because the business of distributing milk lends itself so well to large-scale organization, the farmers' market for milk has come to be limited to a few powerful buyers, together with a number of smaller buyers of uncertain responsibility. In most rural communities there is but little choice of markets for milk. Under these conditions it is inevitable that the farmers should be organized for collective bargaining. Only by conferences between the representatives of the farmers and of the buyers can the conditions of the supply of milk, and of the demand for it, be brought to a satisfactory focus.

THE DAIRYMEN'S LEAGUE, INC.

The first bargaining association of much importance in New York was the Dairymen's League, Inc. This association was organized in 1907 but was not very active until 1916, when the price of milk, relative to the general price level, fell to such a low point that a strike resulted. The Dairymen's League, Inc., was the principal bargaining agent for the producers until 1921, when it was superseded by the Dairymen's League Cooperative Association, Inc., a milk-marketing organization.

During the life of the Dairymen's League, Inc., no satisfactory method of price determination was evolved. Cost of production as computed from the "Warren formula," and butter and cheese values with certain differentials, failed to give complete satisfaction. From 1917 to 1919 the Federal Food Administration was a dominant factor in the price determination, and helped to maintain peace between the producers and the dealers.

The Dairymen's League, Inc., had no remedy for the demoralized market conditions which resulted in 1920 when foreign purchases of canned milk abruptly ceased. In October of that year most of the condenseries closed, refusing to pay the price demanded by the League for milk.

THE DAIRYMEN'S LEAGUE COOPERATIVE ASSOCIATION, INC.

The Dairymen's League Cooperative Association, Inc., was organized in 1919 by the leaders of the Dairymen's League, Inc. Originally the chief purpose of the new organization was to stabilize the market for fluid milk by taking care of the surplus milk in its own plants. The association began operating several country plants in April, 1920. With the closing of the condenseries in October, 1920, the cooperative association expanded its operations rapidly. Many additional country plants were purchased or leased, and some were built. In May, 1921, the cooperative association assumed all the bargaining functions of the Dairymen's League, Inc., and began selling milk under the multiple-price plan, pooling the returns from all milk sold to dealers or handled thru its own plants.

In May, 1922, the association ceased selling milk for nonmembers, and required its customers to give preference to the association in the classification of milk according to use. At this time the Sheffield Farms Co., Inc., and several of the smaller dealers, ceased buying milk from the association. Since May, 1922, some dealers have bought milk only from the association, others have bought part of their supply from the association, and still others have bought entirely outside.

At first a large proportion of the milk pooled thru the Dairymen's League Cooperative Association, Inc., was manufactured. The pool price paid by the association was considerably lower than the prices received by nonmembers who sold directly to fluid-milk dealers. This led to a considerable reduction in membership. During 1923 and 1924, additional markets for fluid milk were developed. Four milk-distributing companies in New York City were purchased by the association.[21] The wholesale business purchased from the Levy Dairy Co., Inc., is being conducted by the association, but all other distributing business purchased in New York has been resold to the Borden's Farm Products Co., Inc. Some of the manufacturing plants previously operated by the association have been sold, and others have been leased to proprietary dealers.

In February, 1925, the association was operating one hundred and sixty-six country plants, was distributing milk at wholesale in New York City and in Newark, and was operating a retail business in Auburn, New York. The association also sells milk to other dealers, some of the milk being delivered directly to the dealers' plants by the farmers, and some being handled thru plants operated by the association.

An increasing proportion of the pooled milk has been sold for distribution as milk or cream, with a corresponding decrease in the amount used for manufacturing (table 11). The percentage of pooled milk used

TABLE 11. PERCENTAGE OF POOLED MILK UTILIZED IN EACH CLASSIFICATION

Month and year	Class 1, fluid milk	Class 2, cream	Class 3, condensed and evaporated milk	Class 4a, butter	Class 4b, cheese
	Per cent				
May:					
1921	37	19	13	16	15
1922	27	30	24	10	9
1923	34	22	33	8	3
1924	43	20	20	15	4
1925	45	21	19	12	3
November:					
1921	51	18	13	12	6
1922	56	19	18	4	3
1923	60	20	12	6	2
1924	73	15	7	4	1
1925	74	19	6	1	0

[21] Properties of the following companies were purchased: Levy Dairy Co., Inc.; Empire State Dairy Co., Inc.; Clover Farms Co., Inc.; and Evans Dairy Co., Inc.

in Class 1 increased from 37 per cent in May, 1921, to 45 per cent in May, 1925, and from 51 per cent in November, 1921, to 73 per cent in November, 1924.

The cooperative association pools the returns from all milk sold or used for manufacturing, whether the milk is handled thru its own plants or thru dealers' plants. Deductions from the gross returns are made each month to cover expenses. A deduction has also been made each month for the capital account. These deductions are classified under several headings in the monthly statements to members. The average pool prices and deductions for four years, from May, 1921, to April, 1925, are given in table 12:[22]

TABLE 12. AVERAGE POOL PRICES AND DEDUCTIONS, DAIRYMEN'S LEAGUE COOPERATIVE ASSOCIATION, INC.

	Twelve months ending with April				
	1922	1923	1924	1925	Average
Gross pool price	$2.011	$2.086	$2.096	$2 022	$2.054
Deductions:					
Administrative expense	0 030	0.029	0 023	0.033	0.029
Local associations	0 002	0 002	0 003	0.003	0 003
Advertising	0.010	0.011	0.020	0.015	0.014
Bad accounts	0.004	0.003	0.004	0 003	0 003
Extra depreciation	0.005	0.027	0 013	0.010	0.014
Extra hauling	......	......	0.027	0.018	0.011
Total expense	$0.051	$0.072	$0.090	$0.082	$0.074
Net pool price	1.960	2.014	2.006	1.940	1.980
Certificates of indebtedness	0.167	0.146	0.083	0.075	0.118
Cash price	1.793	1.868	1.923	1.865	1.862

At the end of each fiscal year, certificates of indebtedness are issued to cover the deductions made for the capital account. These certificates have a term of five years and bear interest at 6 per cent. About two-thirds of the capital is obtained from this source. The balance sheet as of April 30, 1925, is as follows:[23]

CONDENSED GENERAL BALANCE SHEET, APRIL 30, 1925

Assets

Land, buildings, and equipment		$9,975,291.09
Less: Mortgages and contracts payable	$ 222,514.52	
Reserve for depreciation	2,402,859.38	
Reserve for extraordinary depreciation	586,283.28	
Total		3,211,657.18
Net total — land, buildings, and equipment		$6,763,633.91
Cash, capital account		2,066,727.98
Cash, sinking fund		88,375.31
Cash, current account		1,315,364.46
Securities, bonds and mortgages		102,935.21

[22] Monthly prices and deductions are given in the appendix, table 27, page 51.
[23] Dairymen's League News, July 24, 1925, p. 3.

Notes receivable		$ 656,369.11
Accounts receivable		7,109,266.08
Finished product on hand and in process		173,146.29
Raw materials and supplies		466,454.88
Deferred charges:		
Prepaid taxes, insurance, etc	$109,845.43	
Patents and trade-marks	135.00	
Total deferred charges		109,980 43
Total assets		$18,852,253 66

Liabilities

Certificates of indebtedness:		
Issued prior to April 1, 1922		$ 495,061.19
Series "A"— Due May 1, 1927		3,136,252.51
Series "B"— Due May 1, 1928		4,445,634.23
Series "C"— Due May 1, 1929		2,536,964.50
Series "D"— Due May 1, 1930		1,762,569 94
Total certificates of indebtedness		$12,376,482.37
Deductions from members, for which certificates of indebtedness will be issued April 1, 1926		203,747 91
Due members for milk		4,694,479.04
Accounts payable		475,303 56
Accrued interest on certificates of indebtedness and mortgages		667,121.72
Accrued taxes, insurance, etc		30,063 29
Due local and subdistrict organizations		58,389 23
Reserves:		
Uncollectible accounts	$305,627 55	
Advertising	656.70	
Fire insurance	7,083 70	
Budgeted expenses	33,298.59	
Total reserves		346,666 54
Total liabilities		$18,852,253.66

The balance sheet of the association is very conservative. A big advertising campaign was charged to expense. Good will and trade-marks are carried in the balance sheet at a nominal figure, representing only the cost of registering the trade-marks. Large reserves have been set up for depreciation on plants and on equipment.

THE EASTERN STATES MILK PRODUCERS, INC.

A considerable number of farmer-owned milk plants, most of them organized between 1916 and 1920, continue as independent companies. About fourteen of these companies are loosely federated in an association known as the Eastern States Milk Producers, Inc. Most of these plants are located in the Mohawk Valley. Their milk is sold largely to wholesale distributors in New York City. Each of the plants is an independent unit. The federation helps the individual plants to keep in touch with market conditions, and attends to some legal and other matters; but it is not a selling agency, and it has no direct control over the individual plants.

OTHER COOPERATIVE GROUPS

When the Dairymen's League Cooperative Association, Inc., ceased selling milk for nonmembers, other groups of producers were organized

for collective bargaining. The first of these was the Non-Pooling Dairymen's Association. This organization has an executive committee which meets each month with buyers to agree on prices. It is financed by a fee of 1 cent per 100 pounds of milk, which is deducted by the buyer from the amount due to the member for milk and is paid directly to the association. The membership is comparatively small.

After the Sheffield Farms Co., Inc., ceased buying milk from the Dairymen's League Cooperative Association, Inc., the Sheffield Farms Producers' Association was organized. All patrons of the Sheffield Farms Co., Inc., are automatically included in the membership of this association. The membership is divided into a number of groups, according to location. The price committee consists of one representative from each group. It meets once a month with representatives of the company to agree on prices. The expenses of this association are covered by a fee of 0.5 cent per 100 pounds of milk, deducted by the company from the amounts due to all patrons and paid directly to the association.

SUMMARY

The New York milk market is the primary market for a large part of the milk produced in New York State and in several counties in Pennsylvania, New Jersey, and Vermont. This market includes a population of nearly nine millions. In 1924 a daily average of 81,685 forty-quart cans of milk and 4731 forty-quart cans of cream was received at this market. During the six years ending with 1924, milk receipts increased at the rate of 3.6 per cent a year and cream receipts increased at the rate of 7.6 per cent a year.

About 68 per cent of the milk produced in the counties tributary to the New York market is available for shipment to this market; the remaining 32 per cent is used on the farms, consumed in local markets, or shipped to other cities. Only about 53 per cent of the milk is handled thru fluid-milk-shipping stations and condenseries which supply the New York market. In 1923, the receipts of fluid milk at New York amounted to 61 per cent of the total volume handled by shipping stations and condenseries in the shipping area. The percentage of surplus milk varied from 53 per cent in June to 20 per cent in November.

The supply of milk available for the New York market has been increased by extending the shipping area, by providing better transportation facilities for communities away from the railroads, and by effecting larger production per cow. The shipping area probably will not be extended so rapidly in the future, as most of the good dairy regions from which milk can be shipped economically to New York are already shipping to New York or other markets. Cream will probably be shipped in larger quantities from the Middle West and from Canada.

The most important dairy products manufactured at the country plants are cheese, condensed and evaporated milk, and butter. Condensed and evaporated milk yield higher returns on the raw milk than does butter or cheese, but lower returns than does fluid milk or cream. Cheese and butter can be made with only a small investment in equipment. These products usually offer the most profitable outlet for surplus milk where it occurs in small quantities that cannot be assembled economically at a condensery.

In most instances, skimmilk has but little value when used for manufacturing, and in many cases no profitable use is made of it at the country plants. It is possible that considerable saving could be made by doing more separating of milk on the farms, and by delivering cream instead of whole milk to some of the country plants. The practice is now limited to relatively few plants in the New York territory, but it is more general in New England.

During the four years ending with April, 1925, the distributors' gross margin on Grade B milk retailed in bottles was about 7 cents a quart, or about 50 per cent of the retail price. The distributors' margin on milk sold at wholesale was considerably less. The gross margin covers the costs of operating country plants, the cost of pasteurizing and bottling the milk, the cost of delivery, and other distributing costs. In the New York market the greater part of the milk is distributed by two large companies, but there are also many small distributors. Nearly half of the milk is distributed thru stores and restaurants, and the smaller distributors are chiefly occupied in supplying the stores and restaurants with bulk milk.

There are two types of cooperation among the milk producers of the territory: the Dairymen's League Cooperative Association, Inc., and the Eastern States Milk Producers, Inc., operate country plants; the Sheffield Farms Producers' Association and the Non-Pooling Dairymen's Association are collective bargaining agencies.

APPENDIX

TABLE 13. MONTHLY RECEIPTS OF MILK AT THE NEW YORK MARKET, 1896–1925*
(In thousands of forty-quart cans)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1896	628	598	645	660	757	688	708	692	647	670	655	649	7,997
1897	642	581	670	674	739	727	783	718	712	710	680	695	8,331
1898	679	638	738	703	759	776	820	777	761	750	719	708	8,830
1899	711	639	745	746	823	862	848	785	741	744	717	715	9,076
1900	732	672	787	785	843	846	864	806	777	777	742	760	9,389
1901	757	688	797	781	842	892	947	832	807	830	801	784	9,758
1902	796	721	835	826	917	924	928	874	852	869	832	821	10,197
1903	814	767	904	880	1,013	941	1,034	932	916	899	888	889	10,876
1904	879	850	941	927	1,059	1,043	1,061	1,041	966	1,003	938	932	11,640
1905	908	852	970	962	1,075	1,113	1,176	1,104	1,039	1,076	1.034	1,041	12,350
1906	1,033	933	1,089	1,095	1,213	1,267	1,286	1,238	1,197	1,171	1,117	1,123	13,763
1907	1,097	1,011	1,156	1,146	1,281	1,306	1,375	1,269	1,210	1,189	1,136	1.151	14,327
1908	1,139	1,071	1,176	1,171	1,295	1,328	1,354	1,247	1,177	1,216	1,153	1,184	14,512
1909	1,173	1,070	1,245	1,217	1,326	1,388	1,361	1,272	1,237	1,300	1,211	1,226	15,026
1910	1,196	1,139	1,319	1,303	1,406	1,419	1,481	1,360	1,294	1,324	1,284	1,296	15,820
1911	1,293	1,206	1,379	1,342	1,534	1.484	1,588	1,468	1,388	1,385	1,343	1,346	16,757
1912	1,353	1,293	1,426	1,380	1,539	1,576	1,577	1,471	1,431	1,462	1,389	1,426	17,323
1913	1,423	1,323	1,494	1,450	1,584	1,633	1,635	1,538	1,476	1,460	1,438	1,476	17,930
1914	1,468	1,355	1,481	1,467	1,657	1,644	1,595	1,552	1,495	1,508	1,436	1,501	18,158
1915	1,498	1,407	1,581	1,573	1,666	1,657	1,724	1,671	1,633	1,598	1,530	1,539	19,078
1916	1,565	1,458	1,603	1,571	1,739	1,744	1,817	1,758	1,608	1,404	1,496	1,589	19,352
1917	1,578	1,448	1,659	1,634	1,821	1,810	1,869	1,839	1,646	1,520	1,480	1,525	19,829
1918	1,542	1,435	1,694	1,711	1,955	1,952	2,011	2,002	1,780	1,810	1,612	1,651	21,155
1919	1,633	1,569	1,845	1,793	1,999	2,092	2,101	1,959	1,911	1,931	1,825	1,845	22,502
1920	1,835	1,761	1,961	1,946	2,213	2,249	2,256	2,146	2,027	2,075	1,953	1,992	24,395
1921	1,978	1,857	2,143	2,111	2,289	2,414	2,427	2,229	2,262	2,155	1,826	2,012	25,731
1922	2,050	1,908	2,209	2,156	2,479	2,475	2,412	2,302	2,233	2,285	2,133	2,154	26,798
1923	2,170	2,002	2,295	2,297	2,550	2,747	2,589	2,479	2,411	2,403	2,282	2,335	28,559
1924	2,362	2,237	2,470	2,396	2,577	2,637	2,684	2,646	2,501	2,550	2,403	2,434	29,897
1925	2,413	2,281	2,603	2,500	2,676	2,902	2,761	2,673	2,647	2,587	.....	.....	.....
1926	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1927	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1928	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

*Compiled from the *Milk Report*.

TABLE 14. MONTHLY RECEIPTS OF CREAM AND PLAIN CONDENSED MILK AT THE NEW YORK MARKET, 1896–1925*
(In hundreds of forty-quart cans)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1896	17	17	19	27	40	34	37	33	20	19	19	18	299
1897	17	17	19	24	32	36	37	30	27	21	19	20	298
1898	18	18	23	25	35	44	46	42	34	26	24	22	357
1899	22	21	26	32	46	56	49	45	33	31	27	26	413
1900	25	24	28	34	48	52	50	46	33	29	27	26	423
1901	26	24	30	34	47	59	60	49	40	33	30	29	460
1902	29	30	36	39	54	59	58	50	40	35	32	31	494
1903	30	29	39	43	66	61	70	54	48	39	36	34	550
1904	32	33	38	45	73	77	60	65	53	45	41	37	598
1905	38	35	47	56	84	94	96	71	55	51	42	41	710
1906	41	38	49	60	86	100	93	81	64	51	44	42	748
1907	42	38	53	56	76	97	104	81	61	43	42	39	734
1908	40	37	49	57	84	93	88	69	51	44	37	37	685
1909	39	39	47	61	88	101	94	74	58	47	46	42	737
1910	42	41	58	69	96	105	109	80	66	56	48	46	816
1911	48	48	58	69	116	118	118	101	72	56	50	50	904
1912	44	46	57	76	112	120	113	92	73	62	51	43	900
1913	53	48	66	73	113	125	117	98	68	66	57	58	941
1914	53	51	64	75	125	127	115	106	81	65	51	52	964
1915	52	53	64	91	113	125	119	104	89	67	60	49	987
1916	51	55	70	83	131	138	135	115	84	57	54	48	1,021
1917	52	54	74	89	110	147	131	107	71	47	43	41	966
1918	40	40	59	82	133	134	131	117	82	58	49	56	980
1919	47	58	71	91	127	149	134	112	93	81	65	65	1,093
1920	59	64	88	100	143	182	166	135	112	87	66	69	1,270
1921	72	75	102	125	162	172	173	133	116	91	79	79	1,380
1922	82	85	116	142	209	220	190	164	134	115	92	89	1,637
1923	86	87	117	143	207	237	195	168	136	106	90	95	1,667
1924	95	100	131	154	205	224	214	180	129	112	91	97	1,732
1925	101	91	130	150	195	237	192	163	147	112	.....	.....	.....
1926	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1927	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1928	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

*Compiled from the *Milk Reporter*.

TABLE 15. INDEX NUMBERS OF SEASONAL VARIATION IN THE NEW YORK MARKET RECEIPTS

(Secular trend removed)

Month	Milk		Cream	
	1910–1914	1920–1924	1910–1914	1920–1924
January	93.8	93.0	64.4	64.0
February	96.4	94.7	68.6	72.0
March	98.3	98.0	80.3	87.2
April	99.0	99.2	98.5	107.2
May	106.2	106.1	147.3	143.2
June	110.0	112.9	160.9	164.6
July	107.8	107.5	149.5	143.6
August	100.8	102.1	124.1	118.7
September	99.6	101.8	96.5	97.9
October	96.8	98.4	78.7	76.2
November	96.3	93.5	68.0	63.2
December	95.0	92.8	63.2	62.2

TABLE 16. INDEX NUMBERS OF MONTHLY RECEIPTS OF MILK IN THE NEW YORK MARKET*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1910	89	90	93	93	91	91	94	92	91	92	93	92
1911	96	96	97	96	99	95	100	99	98	97	97	96
1912	100	102	101	99	100	102	100	99	101	102	101	10[illegible]
1913	105	105	105	104	102	105	104	104	104	102	104	105
1914	109	108	104	106	108	106	101	105	105	106	104	106
1915	111	112	111	113	108	107	109	113	115	112	111	109
1916	116	116	113	113	113	112	115	119	113	98	109	113
1917	117	115	117	117	118	117	118	124	116	106	107	108
1918	114	113	119	123	127	126	127	135	125	127	117	117
1919	121	125	130	129	130	135	133	132	134	135	132	130
1920	136	140	138	140	142	145	143	145	143	145	141	141
1921	147	148	151	152	147	155	154	151	159	150	133	143
1922	151	152	156	155	160	160	153	155	157	160	154	152
1923	161	159	162	165	164	177	164	167	170	168	165	165
1924	175	178	174	173	167	170	170	179	176	178	174	173
1925	179	181	183	180	174	187	175	181	186	181	...	....
1926	....	....	..	....	...	....	....	....	....	....	....	....
1927	....	....	.. .	.. .	....	....	....	....	....	....	....	...
1928	....	....	....	.. .	....	. .	....	....	....	....	....	....

* Average for the corresponding months, 1910 to 1914, = 100.

TABLE 17. INDEX NUMBERS OF MONTHLY RECEIPTS OF CREAM AND PLAIN CONDENSED MILK IN THE NEW YORK MARKET *

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1910	88	87	95	96	86	88	96	84	92	92	94	92
1911	100	102	95	96	104	99	104	106	100	92	98	100
1912	92	98	93	106	100	101	99	97	101	102	100	86
1913	110	102	108	101	101	105	103	103	94	108	112	116
1914	110	109	105	104	116	107	101	112	113	107	100	104
1915	108	112	105	126	101	105	104	108	124	110	118	98
1916	106	117	115	115	117	116	118	121	117	93	106	96
1917	108	115	121	124	98	124	115	113	99	77	84	82
1918	83	85	97	114	119	113	115	123	114	95	96	112
1919	98	123	116	126	113	125	118	118	129	133	127	130
1920	123	136	144	139	128	153	146	142	156	142	129	138
1921	150	160	167	174	145	145	152	140	161	149	155	158
1922	171	180	190	197	187	185	167	173	186	188	180	178
1923	179	185	192	199	185	199	171	177	189	174	176	190
1924	198	213	215	214	183	188	188	189	179	184	178	195
1925	210	194	213	208	174	199	168	172	204	184	...	....
1926	...		...	...	...	...	...	...	....	...	...	....
1927	....		...	...	....	....	...	...	...	...	...	...
1928	...	....	...	....	....	...	....		...	...	...	...

* Average for the corresponding months, 1910 to 1914, = 100.

TABLE 18. PURCHASING POWER OF NEW YORK FACTORY WAGES IN TERMS OF MILK

Year	Weekly earnings* of factory workers in New York State	Retail prices of bottled milk (cents per quart)	Quarts of milk for one week's earnings	Index of purchasing power of wages in terms of milk (1914 = 100)
1914	$12.48†	9.0	138.7	100
1915	12.85	9.0	142.8	103
1916	14.43	9.2	157.5	114
1917	16.37	12.0	137.0	99
1918	20.35	14.3	142.3	103
1919	23.50	16.0	146.9	106
1920	28.15	16.7	168.6	122
1921	25.72	15.1	170.6	123
1922	25.04	14.5	172.6	124
1923	27.24	15.0	182.1	131
1924	27.68	14.1	196.3	142
1925	....	....	....	....
1926	....	....	....	....
1927	....	....	....	....
1928	....	....	....	....

* The Industrial Bulletin (Albany, New York), vol. 3, p. 299. 1924.
† This average is for the months of June to December, inclusive.

CALCULATION OF THE SUPPLY OF MILK AVAILABLE FOR SHIPMENT TO THE NEW YORK MARKET

At least 95 per cent of the milk received at the New York market is shipped from the counties shown in figure 16. The approximate number of cows, the production of milk, and the volume of milk delivered to the country milk plants in these counties, are shown in table 19.

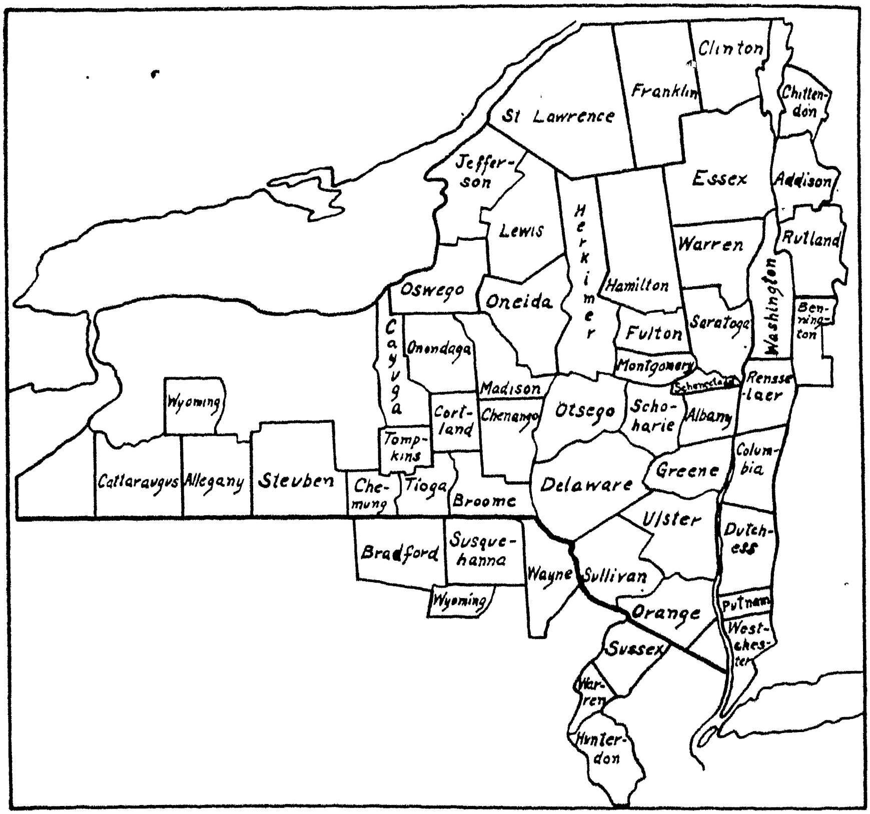

FIGURE 16. COUNTIES OF NEW YORK, NEW JERSEY, PENNSYLVANIA, AND VERMONT WHICH ARE TRIBUTARY TO THE NEW YORK CITY MILK MARKET

It is estimated that more than 95 per cent of the milk, and more than 75 per cent of the cream, received at the New York market is shipped from these counties

TABLE 19. APPROXIMATE DAIRY STATISTICS FOR COUNTIES OF THE NEW YORK MILK-SHIPPING AREA

Counties in	Number of cows* (thousands)		Milk produced per cow annually† (pounds)		Total milk produced‡ (millions of pounds)		Milk delivered to country plants§ (millions of pounds): All country plants		Milk delivered to country plants§ (millions of pounds): Shipping stations and condenseries	
	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923
New York...	1,195	1,177	5,041	5,098	6,023	6,002	4,275	4,222	3,320	3,331
New Jersey..	47	47	5,516	5,470	262	256	124	120	97	95
Pennsylvania..	102	101	5,163	5,348	527	538	374	379	291	300
Vermont	88	86	5,023	5,017	441	434	157	153	122	120
Total.....	1,432	1,411	5,065	5,123	7,253	7,230	4,930	4,874	3,836	3,846

* Number of cows in New York counties as reported by the New York State Department of Farms and Markets, Bul. 158, p. 24, and Bul. 170, p. 14. Estimates for counties of other States based on the federal census of 1920.

† Production of milk per cow in New York counties as reported by the New York State Department of Farms and Markets, Bul. 158, p. 24, and Bul. 170, p. 14. Estimates for counties in other States based on the statistics for adjoining counties in New York.

‡ The total milk production is the product of the number of cows and the production per cow.

§ The quantity of milk delivered to country plants in New York counties is computed from reports made to the New York State Department of Farms and Markets by all plants receiving milk or cream from farmers. It was assumed that the same proportion of all milk produced in the other counties was delivered to country plants, but that only two-thirds of the milk in New Jersey, and one-half of the milk in Vermont, are tributary to the New York market; the remaining fractions of the supply being tributary to Philadelphia and Boston, respectively. Country ice-cream factories and candy factories are included with the shipping stations and condenseries.

The monthly supply of milk was calculated by applying to the yearly totals the percentages of milk delivered each month at the country plants in the New York counties. These monthly percentages are given in table 20:

TABLE 20. PERCENTAGES OF THE ANNUAL SUPPLY OF MILK RECEIVED EACH MONTH AT COUNTRY PLANTS IN NEW YORK COUNTIES THAT ARE TRIBUTARY TO THE NEW YORK MARKET*

Month	All country plants		Shipping stations and condenseries	
	1922	1923	1922	1923
January	5.9	5.8	6.6	6.5
February	5.6	5.6	6.5	6.2
March	7.8	7.3	8.5	8.0
April	9.1	8.9	9.2	9.1
May	11.6	11.5	11.3	11.3
June	12.5	13.2	11.7	12.5
July	10.7	11.4	10.0	10.6
August	9.3	9.1	8.6	8.5
September	8.5	8.0	8.0	7.5
October	7.7	7.7	7.6	7.4
November	5.8	5.9	6.0	6.1
December	5.5	5.6	6.0	6.3
Year	100.0	100.0	100.0	100.0

* Calculated from records of the New York State Department of Farms and Markets.

The approximate quantities handled by the country plants of the whole-milk-shipping area each month are given in table 21:

TABLE 21. APPROXIMATE QUANTITIES OF MILK HANDLED MONTHLY BY COUNTRY PLANTS IN THE NEW YORK MILK-SHIPPING AREA

(Millions of pounds)

Month	All country plants		Shipping stations and condenseries	
	1922	1923	1922	1923
January	290.9	282.7	262.5	254.0
February	276.1	272.9	258.5	246.1
March	384.6	355.8	334.0	317.5
April	448.7	433.8	369.8	361.2
May	571.9	560.5	453.3	444.5
June	616.3	643.4	461.3	500.1
July	527.5	555.6	397.7	424.7
August	458.5	443.5	342.0	337.4
September	419.1	389.9	318.1	297.7
October	379.6	375.3	302.2	293.7
November	286.0	287.6	238.6	242.1
December	271.2	272.9	238.6	250.0
Year	4,930.3	4,873.9	3,976.6	3,968.9

The daily average quantities of milk handled by the country plants each month, and the daily average receipts at the New York market, are given in table 22:

TABLE 22. DAILY AVERAGE QUANTITIES OF MILK HANDLED BY COUNTRY PLANTS IN THE NEW YORK MILK-SHIPPING AREA, AND DAILY AVERAGE RECEIPTS OF MILK, AND OF MILK AND CREAM IN TERMS OF PLAIN MILK, AT THE NEW YORK MARKET

(Millions of pounds)

	All country plants		Shipping stations and condenseries		New York market*			
					Milk		Milk and cream	
	1922	1923	1922	1923	1922	1923	1922	1923
January	9.4	9.1	8.5	8.2	5.6	6.0	7.2	7.6
February	9.9	9.7	9.2	8.8	5.8	6.1	7.6	7.9
March	12.4	11.5	10.8	10.2	6.1	6.3	8.3	8.5
April	15.0	14.5	12.3	12.0	6.1	6.5	8.9	9.3
May	18.4	18.1	14.6	14.3	6.8	7.0	10.8	11.0
June	20.5	21.4	15.4	16.7	7.0	7.8	11.4	12.5
July	17.0	17.9	12.8	13.7	6.6	7.1	10.3	10.8
August	14.8	14.3	11.0	10.9	6.3	6.8	9.5	10.0
September	14.0	13.0	10.6	9.9	6.3	6.8	9.0	9.5
October	12.2	12.1	9.7	9.5	6.3	6.6	8.5	8.6
November	9.5	10.0	8.0	8.1	6.0	6.5	7.9	8.2
December	8.7	8.8	7.7	8.1	5.9	6.4	7.6	8.2

* Computed from data published in the *Milk Reporter*.

TABLE 23. Shipments of Cream from Western States to the New York Market

(Forty-quart cans)

Month	Wisconsin	Illinois	Michigan	Minnesota	Iowa	Indiana	Ohio	Total	Per cent of New York cream receipts from the West*
1924									
May..........	5,494	......	......	810	......	......	......	6,304	4.4
June..........	3,000	......	.. ...	157	......	......	......	3,157	2.0
July..........	4,400	600	......	......	......	......	......	5,000	3.3
August........	12,059	2,654	2,435	......	......	200	677	18,025	14 3
September.....	8,068	7,326	1,064	620	......	400	200	17,678	19.6
October.......	4,382	.. . .	621	......	......	430	200	5,633	7.1
November.....	12,292	8,017	977	805	200	200	.... .	22,491	35.5
December.....	14,436	6,409	1,592	2,733	600	200	900	26,870	39 4
1925									
January.......	11,250	4,282	1,197	1,259	200	1,100	1,417	20,705	29.4
February......	10,060	2,674	2,422	2,404	2,380	100	1,200	21,240	33.2
March........	9,406	400	1,363	2,294	3,236	.. ...	400	17,099	18.7
April..........	4,200	800	....	800	1,600	......	......	7,400	7.1
Year........	99,047	33,162	11,671	11,882	8,216	2,630	4,994	171,602	14.2

* Only high-test cream was shipped from the West, while the New York receipts include various tests of cream and also plain condensed milk. The western cream was, therefore, expanded by 10 and the New York receipts by 7, to convert to the approximate equivalent of whole milk.

TABLE 24. Index Numbers of the Quantities of Milk Delivered per Dairy Each Month at 30 Shipping Stations in New York State*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1910...	94.6	95.6	98.0	101.4	104.5	103.5	108.5	105.7	106.1	107.6	105.3	105.3
1911........	107.0	108.4	111.1	111.5	105.0	104.2	108.2	109 3	106.7	106.1	103.1	104.1
1912..........	100.8	104.3	99 8	97.3	97 8	100.2	93.5	98.8	102.2	101.2	101.7	101.5
1913..........	100.8	98.0	96.5	94.8	98.2	96 7	94.4	92.9	93.9	94.5	98.3	98.1
1914...	96.9	93 6	94.7	95.0	94.1	95 2	95.4	93.3	91.1	90.6	91.6	90.9
1915..........	90.9	90.8	90.9	89.1	89.9	89.1	92.4	98.2	94.6	94.7	91.1	85.7
1916....	85.7	88 3	85.6	81.6	87.8	94.3	99.0	99.2	88.9	52.3	83.2	82.7
1917..........	82.1	84.9	81.6	82.4	76.7	90.3	99 7	98.1	93.2	85.3	81.8	82.1
1918...	80.6	79 3	78.1	77.5	92.7	87.1	92.4	91.0	84.5	79.2	77.1	82.5
1919...	81.7	80.0	81.7	85 5	88.1	92 6	95.2	98.8	90.3	88.3	85.7	85.5
1920.....	85.4	83.5	83 0	87.1	85 7	93 2	98.2	99.9	99.6	100.8	95.4	93.6
1921..........	93.8	94.5	94.6	97.6	99 9	91.8	95.1	115.0	107.9	103.4	95.8	98.7
1922..........	95.6	96.7	97 6	95 1	92.2	91.8	95.5	106.6	107.6	107.1	99.9	99.8
1923..........	100.2	98.5	94.5	94.6	92 2	97.3	100.8	104.0	101.8	106.2	104.4	102.2
1924..........	101.7	104.6	100.0	96.9	91.7	98.8	103.6	101.7	103.2	104 9	105.4	102.1

*Average for the corresponding months, 1910 to 1914, = 100.

TABLE 25. MONTHLY AVERAGE* PRICES QUOTED TO DEALERS BY THE DAIRYMEN'S LEAGUE COOPERATIVE ASSOCIATION, INC., FOR 3-PER-CENT† MILK IN THE 201–210-MILE FREIGHT ZONE

Month	Class 1, fluid milk	Class 2, cream‡	Class 3, condensed and evaporated milk	Class 4a, butter‡	Class 4b, cheese
1921:					
May	$2.30	$2.10	$1.80	$0.89	$0.88
June	1.95	1.55	1.50	0.92	0.82
July	2.20	1.55	1.50	1.24	1.18
August	2.90	2.25	1.79	1.34	1.34
September	2.90	2.25	1.80	1.35	1.38
October	3.37	2.25	1.87	1.52	1.48
November	3.37	2.25	1.79	1.43	1.40
December	3.37	2.25	1.49	1.38	1.36
1922:					
January	3.10	2.10	1.24	1.12	1.33
February	3.00	1.70	1.34	1.11	1.25
March	2.17	1.50	1.39	1.16	1.32
April	2.08	1.50	1.37	1.13	1.08
May	1.75	1.50	1.28	1.09	1.00
June	1.75	1.50	1.27	1.09	1.22
July	2.22	1.75	1.30	1.07	1.35
August	2.69	2.00	1.41	1.03	1.33
September	2.90	2.00	1.78	1.27	1.56
October	2.90	2.00	1.89	1.47	1.79
November	2.90	2.25	2.14	1.71	1.99
December	3.37	2.90	2.29	1.86	1.93
1923:					
January	3.14	2.60	2.29	1.63	1.93
February	2.90	2.50	2.22	1.56	1.80
March	2.80	2.50	2.20	1.54	1.77
April	2.80	2.25	2.07	1.43	1.49
May	2.33	2.15	1.90	1.39	1.55
June	2.33	2.20	1.83	1.33	1.71
July	2.33	2.25	2.04	1.40	1.75
August	2.58	2.25	2.22	1.56§	1.76
September	2.98	2.25	2.25	1.63	1.88§
October	3.12	2.25	2.25	1.69	1.84
November	3.04	2.25	2.20	1.85	1.72
December	2.80	2.25	2.15	1.88	1.49
1924:					
January	2.42	2.25	2.10	1.82	1.42
February	2.33	2.25	2.05	1.74	1.41
March	2.33	2.20	2.00	1.55	1.35
April	2.33	2.10	1.95	1.27	1.03
May	1.86	1.80	1.60	1.28	1.04
June	1.86	1.80	1.55	1.37	1.25
July	1.86	1.80	1.55	1.32	1.30
August	2.30	1.89	1.55	1.27	1.31
September	2.60	2.00	1.45	1.25	1.39
October	2.60	2.00	1.45	1.28	1.28
November	3.07	2.00	1.60	1.42	1.36
December	3.07	2.20	1.80	1.49	1.52
1925:					
January	3.07	2.20	1.90	1.32	1.63
February	3.07	2.20	1.90	1.35	1.62
March	2.93	2.15	1.90	1.58	1.66
April	2.80	2.00	1.90	1.48	1.49

TABLE 25 (*concluded*)

Month	Class 1, fluid milk	Class 2, cream‡	Class 3, condensed and evaporated milk	Class 4a, butter‡	Class 4b, cheese
1925 (*concluded*):					
May	$2.59	$1 96	$1.80	$1.41	$1.35
June	2.33	1.90	1.80	1.41	1.50
July	2 56	1.90	1.90	1.42	1.56
August	2.80	1.95	2.00	1.49	1.65
September	2 80	1.95	2.00	1.66	1.64
October	2 80	2.25	2.10	1.75	1.79
November	2.80	2.25	2.10	1 74	1.77
December	2 80	2 25	2 10	....	....
1926:					
January	....	....	....	....	....
February	....	....	....	....	....
March	....	....	....	....	....
April	....	....	....	....	....

* When the price was changed during the month, the price given is the average of the two prices weighted according to the number of days each was in effect.

† Four cents per 100 pounds additional was paid for each 0.1 per cent of butterfat above 3 per cent.

‡ The prices given include the minimum charge for skimmilk, which varied from nothing to 20 cents per 100 pounds of milk in different months. A maximum charge of 35 cents per 100 pounds of milk was made for the skimmilk when put to profitable uses.

§ These prices and the prices following applied to dealers who used in Class 4 less than 50 per cent of the milk bought. Other dealers paid slightly more.

TABLE 26. COMPONENT PARTS OF THE RETAIL PRICE OF BOTTLED MILK IN NEW YORK CITY

Month	Cents per quart												
	Price at country plant*				Freight	Distributor's margin				Retail price			
	1921–22	1922–23	1923–24	1924–25		1921–22	1922–23	1923–24	1924–25	1921–22	1922–23	1923–24	1924–25
May	5.4	4.2	5.4	4.4	1.1	8.5	7.7	7.5	8.5	15	13	14.0	14.0
June	4.6	4.2	5.4	4.4	1.1	8.3	7.7	7.5	8.5	14	13	14.0	14.0
July	5.2	5.2	5.4	4.4	1.1	7.7	7.7	7.5	8.5	14	14	14.0	14.0
August	6.7	6.2	6.0	5.3	1.1	7.2	7.7	6.9	7.1	15	15	14.0	13.5
September	6.7	6.7	6.8	6.0	1.1	7.2	7.2	7.1	6.9	15	15	15.0	14.0
October	7.7	6.7	7.1	6.0	1.1	6.2	7.2	6.8	6.9	15	15	15.0	14.0
November	7.7	7.7	7.0	7.0	1.1	6.2	6.2	7.4	6.9	15	15	15.5	15.0
December	7.7	7.7	6.5	7.0	1.1	6.2	6.2	7.4	6.9	15	15	15.0	15.0
January	7.1	7.2	5.6	7.0	1.1	6.8	7.7	7.5	6.9	15	16	14.2	15.0
February	6.9	6.7	5.4	7.0	1.1	7.0	7.2	7.5	6.9	15	15	14.0	15.0
March	5.1	6.5	5.4	6.7	1.1	8.8	7.4	7.5	7.2	15	15	14.0	15.0
April	4.9	6.5	5.4	6.5	1.1	8.0	7.4	7.5	7.4	14	15	14.0	15.0
Average	6.3	6.3	6.0	6.0	1.1	7.3	7.3	7.3	7.4	14.7	14.7	14.4	14.5

*Dairymen's League Class-1 price for 3.5-per-cent milk, 201–210-mile zone.

TABLE 27. Pool Price, Deductions, and Cash Price, per 100 Pounds of Milk, Dairymen's League Cooperative Association, Inc., 1921–1925

Month	Pool price	Administrative expenses	Local association expenses	Advertising	Insurance fund, and uncollectible accounts	Decline in value of fixed assets, and extraordinary depreciation	Extraordinary hauling	Certificate of indebtedness	Cash price*
1921:									
May	$1.735	$0.023	$0.002	$0.005	...	...	...	$0.10	$1.605
June	1.455	0.021	0.002	0.007	$0.005	.	...	0.10	1.320
July	1.745	0.024	0.002	0.014	0.005		...	0.10	1.600
August	2.195	0.026	0.002	0.012	0.005	.	...	0.20	1.950
September	2.290	0.030	0.002	0.013	0.005	...	...	0.20	2.040
October	2.520	0.034	0.002	0.009	0.005	....	...	0.20	2.270
November	2.480	0.040	0.002	0.013	0.005	......	...	0.20	2.220
December	2.455	0.050	0.002	0.008	0.005	...	..	0.20	2.190
1922:									
January	2.165	0.038	0.002	0.010	0.005	....	.	0.20	1.910
February	2.045	0.028	0.002	0.020	0.005	$0.02	..	0.20	1.770
March	1.650	0.023	0.002	0.000	0.005	0.02	....	0.20	1.400
April	1.395	0.024	0.002	0.012	0.002	0.02	....	0.10	1.235
May	1.355	0.021	0.002	0.010	0.002	0.02	.....	0.10	1.200
June	1.400	0.020	0.002	0.011	0.002	0.02	...	0.10	1.245
July	1.680	0.028	0.002	0.008	0.002	0.02	..	0.20	1.420
August	1.870	0.034	0.002	0.007	0.002	0.07	...	0.15	1.605
September	2.095	0.031	0.002	0.010	0.002	0.05	..	0.15	1.850
October	2.270	0.026	0.002	0.010	0.002	0.02	..	0.20	2.010
November	2.530	0.030	0.002	0.011	0.002	0.02	...	0.20	2.265
December	2.820	0.030	0.002	0.013	0.005	0.02	..	0.20	2.550
1923:									
January	2.285	0.035	0.002	0.013	0.005	0.02	..	0.10	2.110
February	2.380	0.030	0.002	0.013	0.005	0.02	...	0.10	2.210
March	2.200	0.030	0.002	0.013	0.005	0.02	....	0.10	2.030
April	2.150	0.030	0.002	0.020	0.003	0.02	.	0.15	1.925
May	1.900	0.020	0.002	0.020	0.003	0.02	$0.015	0.10	1.720
June	2.000	0.019	0.003	0.020	0.003	0.02	0.020	0.10	1.815
July	2.080	0.020	0.003	0.020	0.003	0.02	0.029	0.15	1.835
August	2.180	0.020	0.003	0.020	0.003	0.02	0.029	0.10	1.985
September	2.300	0.020	0.003	0.020	0.003	0.02	0.034	0.10	2.100
October	2.420	0.024	0.003	0.020	0.003	0.02	0.030	0.10	2.220
November	2.430	0.024	0.003	0.020	0.003	0.02	0.030	0.10	2.230
December	2.230	0.024	0.003	0.020	0.003	...	0.030	0.05	2.100
1924:									
January	2.000	0.024	0.003	0.020	0.003	.....	0.030	0.05	1.870
February	1.900	0.025	0.003	0.020	0.003	...	0.029	0.05	1.770
March	1.880	0.025	0.003	0.020	0.005	.	0.027	0.05	1.750
April	1.835	0.025	0.003	0.020	0.004	0.01	0.023	0.05	1.700
May	1.485	0.026	0.003	0.020	0.003	0.01	0.023	0.10	1.300
June	1.420	0.029	0.003	0.020	0.003	0.01	0.015	0.10	1.240
July	1.500	0.031	0.003	0.020	0.003	0.01	0.013	0.10	1.320
August	1.720	0.038	0.003	0.020	0.003	0.01	0.011	0.10	1.535
September	1.930	0.036	0.003	0.020	0.003	0.01	0.013	0.10	1.745
October	1.950	0.036	0.003	0.020	0.003	0.01	0.018	0.10	1.760
November	2.350	0.032	0.003	0.020	0.003	0.01	0.022	0.10	2.160
December	2.500	0.031	0.003	0.020	0.003	0.01	0.023	0.10	2.310
1925:									
January	2.500	0.035	0.003	0.010	0.003	0.01	0.024	...	2.415
February	2.380	0.034	0.003	0.005	0.005	0.01	0.023	.	2.300
March	2.330	0.033	0.003	0.005	0.005	0.01	0.019		2.260
April	2.200	0.029	0.003	.....	0.005	0.01	0.018	0.10	2.035
May	1.955	0.029	0.003	...	0.005	9.01	0.018	0.10	1.790
June	1.865	0.030	0.003	......	0.005	0.01	0.017	0.10	1.700
July	1.915	0.032	0.003	...	0.005	0.01	0.015	0.10	1.750
August	2.165	0.032	0.003	..	0.005	0.01	0.015	0.10	2.000
September	2.280	0.032	0.003	....	0.005	0.01	0.015	0.10	2.115
October	2.380	0.032	0.003	.....	0.005	0.01	0.020	0.10	2.210
November	2.480	0.032	0.003	...	0.005	0.01	0.020	0.10	2.310
December	......	....	...	....	....	...	.....	....	......
1926:									
January	......	......	......	....	....	......	.....	..	...
February	.....	....	.....	..	.....	.....	.....	..	.....
March	.....	.....	...	..	..	.....	......	..	....
April	......	......	......	......	......	.....	......	.....	......

* These prices do not include the thirteenth checks drawn at the end of each fiscal year to cover incomplete payments during the year. The amounts of the thirteenth checks were: year ending March 31, 1922, 1.3 cents; year ending March 31, 1923, 1.9 cents; year ending March 31, 1924, 0.3 cent; year ending March 31, 1925, 1 cent.